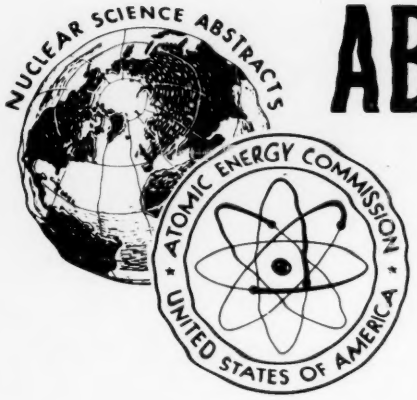
NUCLEAR SCIENCE ABSTRACTS



Volume 28 Number 1

Abstracts 1-2088

July 15, 1973

UNITED STATES ATOMIC ENERGY COMMISSION

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Volume 28, Number 1, July 15, 1973

NUCLEAR SCIENCE ABSTRACTS

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Nuclear Science Abstracts provides the only comprehensive abstracting and indexing coverage of the international nuclear science literature. It covers scientific and technical reports of the U. S. Atomic Energy Commission and its contractors, other U. S. Government agencies, other governments, universities, and industrial and research organizations. In addition, books, conference proceedings, individual conference papers, patents, and journal literature on a worldwide basis are abstracted and indexed. Each issue of *Nuclear Science Abstracts* includes four indexes: subject, personal author, corporate author, and report number.

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Numerous organizations, societies, and publishers throughout the world provide *Nuclear Science Abstracts* with advance page-proof copy of their publications.

A list of the journals scanned regularly and the abbreviations used appears in the January 15 issue of *Nuclear Science Abstracts* and is supplemented in the July 15 issue. The January 15 issue also describes the scope and arrangement of the subject matter covered in *Nuclear Science Abstracts*. The subject matter covered is also described in TID-4552, *Subject Scope of Nuclear Science Abstracts*, available free from the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830. An outline of the subject categories appears in the Contents of each issue.

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DIETZEL, H., HEOS 2 and HELIOS micrometeoroid experiments, 27:20588

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Examples:

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Design of a neutron therapy facility for a 30-inch cyclotron, 27:25413
ACETONE/RADIOLYSIS
Pulse radiolysis of alkyl ketones, 27:24388
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Operating characteristics of two compressed air nebulizers used in inhalation experiments, 27:24522 (LF--45)

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21102 (ORNL-4846) GAMMA-RAY PRODUCTION DUE TO NEUTRON INTERACTIONS WITH COPPER FOR INCIDENT NEUTRON ENERGIES BETWEEN 1.0 AND 20 MeV: TABULATED DIFFERENTIAL CROSS SECTIONS. Dickens, J. K.; Love, T. A.; Morgan, G. L. **(Oak Ridge National Lab., Tenn).** Feb 1973. Contract W-7405-eng-26. 44p. Dep. NTIS $4.00.

is indexed as:

OAK RIDGE NATIONAL LAB., TENN.
Gamma-ray production due to neutron interactions with copper for incident neutron energies between 1.0 and 20 MeV: tabulated differential cross sections, 27:21102 (ORNL-4846)

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73-52(Vol. 1)(No.2)	27-21978	Dep. NTIS, 13p.
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35	27-22017	Dep. NTIS, 98p.

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Public availability of all U. S. Atomic Energy Commission reports is indicated in the report number indexes. The availability of other reports, when known, is also indicated. The availability of some unnumbered reports is given in the abstract.

Dissertations from *Dissertation Abstracts International, Part B* that are included in *Nuclear Science Abstracts* are *available from University Microfilms, Inc.,* 315 N. First Street, Ann Arbor, Michigan 48103.

Information on the availability of the published literature and unpublished conference papers abstracted in *Nuclear Science Abstracts* can be obtained from the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

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Volume 28, Number 1 July 15, 1973

NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

1 (AERE-Bib-184) LIST OF UNCLASSIFIED DOCUMENTS, LECTURES, ETC., BY THE STAFF OF THE CHEMISTRY DIVISION AND THE APPLIED CHEMISTRY DIVISION, A.E.R.E., HARWELL, 1972. Holman, R. J. (comp.) (Atomic Energy Research Establishment, Harwell (England)). Jan 1973. 14p. Dep. NTIS (U. S. Sales Only) $3.00. UK 50 pence.

This list constitutes unclassified material published or presented during 1972 by staff of the Chemistry Division and the Applied Chemistry Division. It covers reports, memoranda, conference papers, books and articles in journals. It includes a few items published in 1971 which did not appear in last year's bibliography (AERE-Bib 179). (auth)

Analytical and Separations Chemistry

Refer also to abstract 607.

2 (STI/PUB-337) ANALYTICAL CHEMISTRY OF NUCLEAR FUELS. Panel Proceedings Series. Proceedings of a Panel, Vienna, Austria, July 13–17, 1970. (International Atomic Energy Agency, Vienna (Austria)). Dec 1972. 227p. (CONF-700732–). IAEA $8.00.

From panel on the analytical chemistry of nuclear fuels; Vienna, Austria (13 Jul 1970).

A separate abstract was prepared for each of the twenty-one papers presented. (DHM)

For abstracts of individual papers see: 68–83, 97–100, and 120.

Activation and Nuclear Reaction Procedures

Refer also to abstracts 168, 558, 742, and 775.

3 (AE-469) RADIOCHEMICAL MACHINE FOR THE ANALYSIS OF Cd, Cr, Cu, Mo, AND Zn. Samsahl, K.; Webster, P. O.; Blomqvist, G. (Aktiebolaget Atomenergi, Studsvik (Sweden)). Feb 1973. 15p. Dep. NTIS (U. S. Sales Only) $3.00.

A fast automatic radiochemical machine for the determination of Cd, Cr, Cu, Mo, and Zn in biological material was developed. The method is based on ion exchange separation combined with gamma spectrometry. The precision of the machine was studied both with added activities and with repeated analysis of the same sample (human heart tissue). The standard deviation of a single value was in both cases <3%. (auth)

4 (BNL-tr-534) DETERMINATION OF THE LOSS OF GOLD, PLATINUM, RUTHENIUM, AND IRIDIUM FOLLOWING CUPELLATION. Georgiev, G. T.; Apostolov, D. Translated by S. J. Amoretty (Brookhaven National Lab., Upton, N. Y.) from Zh. Anal. Khim.; 27: No. 3, 506-511(1972). 16p. Dep. NTIS $3.00.

The loss of gold, platinum, ruthenium, and iridium, which depends on the degree of removal of lead following cupellation, was determined by means of nondestructive neutron activation analysis. The effect of the presence of silver on cupellation, was studied, and it was established that the concentration in a silver bead cannot be used for ruthenium and iridium. If cupellation is continued until lead beads containing 0.02 g silver and weighing ≥0.1 g are formed, the loss of gold, platinum, ruthenium, and iridium will be ≤8% for microgram quantities of these elements. (auth)

5 (CEA-N-1593) FEASIBILITY OF ACTIVATION ANALYSIS IN DRILLINGS. Dumesnil, P. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 6 Jul 1972. 21p. (In French). Dep. NTIS (U. S. Sales Only) $3.25.

The feasibility of using activation analysis techniques in drillings is reviewed: determination of Zn, Cu, Ni, W, Ti, and Co in rocks using isotope neutron sources (^{252}Cf) and measuring the most intense lines of the radiative thermal neutron capture processes; determination of Pb, Co, Ag, F, Al, V, and Fe in rocks using isotope neutron sources (^{252}Cf or Am–Be) or a 14 MeV fast neutron generator and measuring the resulting γ ray lines; and utilization of special methods to determine Be and U. (France)

6 (CEA-R-4413) NONDESTRUCTIVE ANALYSIS OF TRACE ELEMENTS: STUDY OF A MANGANESE NODULE. Zlatanova, R. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Feb 1973. 26p. (In French). Dep. NTIS (U. S. Sales Only) $3.50.

The abundances of 24 elements including 10 rare earth elements were determined in polymetallic manganese nodules via neutron activation followed by fine γ spectrometry. As compared with various rocks of basaltous type, a marked enrichment of the lighter rare earths was noticed. Moreover, the original precipitation process enhanced a number of chemical elements, cerium especially. (auth)

7 (CONF-721010–57) TRACER STUDY OF A CHEMICAL SEPARATION PROCEDURE FOR THE DETERMINATION OF IMPURITIES IN SELENIUM BY MEANS OF THERMAL NEUTRON ACTIVATION ANALYSIS. Verplanke, J. C.; Kuin, P. N. (Philips Gloeilampenfabrieken N. V., Eindhoven (Netherlands). Forschungslaboratorium). 1972. 10p. Dep. NTIS (U. S. Sales Only) $3.00.

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

A chemical separation procedure was developed for the determination of about 50 trace elements in high-purity selenium. The method consists of two distillation steps, followed by a precipitation step. In the first distillation step the halogens, osmium, and, partly, ruthenium are volatilized; in the second the selenium is distilled together with antimony, tin, arsenic, mercury, and germanium. Selenium is precipitated from the second distillate by reduction to the element. The whole procedure was tested by means of radioactive tracers. Interferences from the selenium matrix with respect to the arsenic and bromine determinations are discussed. (France)

8 (CONF-721010-59) DETERMINATION OF RARE EARTHS IN STANDARD REFERENCE MATERIAL GLASS USING NEUTRON ACTIVATION ANALYSIS AND REVERSED-PHASE CHROMATOGRAPHY. McClendon, L. T.; LaFleur, P. D. (National Bureau of Standards, Washington, D. C.). 1972. 8p. NTIS.

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

The rare earth elements in NBS Standard Reference Material 480, Trace Elements in Glass, a sodium glass to which 61 trace elements were added, were determined by neutron activation analysis with a chemical separation using a column (11 cm × 40 cm) of Corvic powder (poly(vinyl chloride)–vinyl acetate) loaded with HDEHP and operated at a constant temperature. The best operating conditions (e.g., time, flow, acid concentration, etc.) using perchloric acid were established. A detailed description of the separation procedure and the quantitative results are discussed. (FR)

9 (CONF-721010-60) DETERMINATION OF Cs, Rb, AND Ba IN NEUTRON ACTIVATED BIOLOGICAL MATERIALS. *Buenafama, H. D.; Rudelli, M. D.* (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1972. 5p. Dep. NTIS (U. S. Sales Only) $3.00.

From International Conference on Modern Trends in Activation Analysis; Saclay, France (2 Oct 1972).

The determination of Cs, Rb and Ba in biological materials, including human bones, eggs, milk, meat and vegetables by neutron activation analysis is described. The proposed technique is based on the measurement of the long lived radioisotopes ^{131}Ba, ^{134}Cs and ^{86}Rb with a Ge(Li) detector, after a simple radiochemical separation based on selective retention of these nuclides on hydrated antimony pentoxide in 6 M HF. Detection limits of 0.001 ppM can be achieved with 5% precision. Data are given for replicate determinations in six different types of materials. (France)

10 (CONF-721010-61) RADIOCHEMICAL AND ACTIVATION ANALYSIS BY EXTRACTION OF DAUGHTER NUCLIDES. Determination of Molybdenum. *Alian, A.; Born, H. J.; Staerk, H.* (Technische Universitaet, Munich (West Germany). Institut fuer Radiochemie). 1972. 9p. Dep. NTIS (U. S. Sales Only) $3.00.

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

Molybdenum was determined in standard rocks, Scheelite ores (from the Alps), and in a plant (Kale). The FRM Reactor (Munich) was used to irradiate the samples with a 10^{13} n/cm^2/sec flux. The separation of the ^{99m}Tc daughter nuclide was performed by a multistage extraction process using HDEHP. It was necessary to make corrections for U interference. (France)

11 (CONF-721010-62) ANALYSIS OF SMALL BIOPSY SAMPLES BY NEUTRON ACTIVATION ANALYSIS. *Batra, G. J.; Bewley, D. K.* (Hammersmith Hospital, London (England)). 1972. 11p. Dep. NTIS (U. S. Sales Only) $3.00.

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

Neutron activation analysis techniques were used to determine Na, Cl, K, and P in bone biopsy samples. The result of the determinations are presented. The samples were irradiated together with the appropriate standards in the neutron beam of the MRC cyclotron. Fast neutron fluxes 5×10^{10} n/cm^2/sec (mean energy = 7.5 MeV) and thermal neutron fluxes 10^9 n/cm^2/sec were used. A NaI(Tl) counter coupled to a multichannel analyzer was used to count the samples. The Ca/P ratio of normal subjects was found to be 2.30; the K/P ratio was found to be almost constant for normal subjects. (France)

12 (CONF-721069-34) SURFACE ANALYSIS USING NUCLEAR REACTIONS TO EVALUATE THE SURFACE BULK MATERIAL INTERFERENCE. *Quaglia, L.; Weber, G.* (Liege Univ. (Belgium). Institut de Physique Nucleaire). 1972. 8p. (In French). Dep. NTIS (U. S. Sales Only).

From international colloquium on the activation analysis of micro-quantities of elements in very high purity inorganic and organic substances and in biological media; Saclay, France (2 Oct 1972).

The effect of surface oxygen, carbon, and nitrogen on the determination of these elements in the bulk material was examined. The surface analysis was effected using nuclear reactions induced by low-energy charged particles obtained with a 2 MeV Van de Graaff accelerator. Many different surface preparations were examined in view of establishing a pre-analysis treatment. (France)

13 (CONF-721069-50) SOME MICROANALYTICAL USES OF SMALL-DIAMETER CHARGED-PARTICLE BEAMS. *Pierce, T. B.* (Atomic Energy Research Establishment, Harwell (England)). 1972. 12p. Dep. NTIS (U. S. Sales Only) $3.00.

From international colloquium on the activation analysis of micro-quantities of elements in very high purity inorganic and organic substances and in biological media; Saclay, France (2 Oct 1972).

Small diameter ion beams are produced with the 3 MeV electrostatic generator IBIS at A.E.R.E. and samples irradiated with protons, deuterons, or α-particles depending upon the application. Beam diameters of the order of 3 μm can be produced. The samples are mounted on a table and can be moved in three dimensions. The region of the sample irradiated can be viewed from the front of the chamber by means of a microscope; a second microscope permits the shape and the size of the beam on the quartz disk to be examined in detail and the beam movement relative to the target to be checked for scanning. Counters are available to detect charged particles, and gamma or x-rays. Some applications of positive ions methods to microanalysis are given: γ-lines of characteristic energy can be produced from most of the light elements and multi-element analysis is possible using γ-ray spectroscopy; the measurement of particles produced by nuclear reactions is an alternative means of determining light elements; elastic scattering can be used to examine thin films of heavy elements on substrates of less heavy elements; characteristic x-rays can be produced by charged particle interactions which offer the basis for sensitive analytical determination. (France)

14 (CONF-721069-51) NEUTRON ACTIVATION ANALYSIS METHOD FOR SAMPLES OF LUNAR ROCK OBTAINED FROM THE MARE FOECUNDITATIS BY LUNA 16. *Surkov, Y. A.; Kirnozov, F. F.; Ivanov, I. N.; Kolesov, G. M.; Rivkin, B. N.; Shpanov, A. P.* 1972. Translated from Russian. 10p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

From international colloquium on the activation analysis of micro-quantities of elements in very high purity inorganic and organic substances and in biological media; Saclay, France (2 Oct 1972).

The elemental compositions of lunar regolith samples obtained from the Mare Foecunditatis were determined by activation analysis. The measurements were made using a neutron generator, a scintillation γ spectrometer, and a Ge(Li) detector. An instrumental activation analysis method and a chemical separation of rare earths after the chemical dissolution of the sample were used. (France)

15 (FRNC-TH-344) ACTIVATION ANALYSIS WITH RAPID CHEMICAL SEPARATION OF MINOR ELEMENTS (P, Si, Al) USING 14 MeV NEUTRONS: APPLICATIONS IN METALLURGY. *D'Anglemont de Tassigny, C.* (Grenoble Univ. (France)). 1972. 109p. (In French). Dep. NTIS (U. S. Sales Only) $7.50.

Thesis. Submitted to Universite Scientifique et Medicale de Grenoble (France).

A method of determining P, Si, and Al in steels by activation with 14 MeV neutrons and chemical separation was studied. These analyses are simultaneously performed on the same sample. A method for the dissolution of the sample and the rapid separation of P by solvent extraction (methyl isobutyl ketone) was developed. A series of successive extractions enabled Fe, Mn, Cr, Cu, and Al, to be subsequently separated. The separation efficiencies are greater than 90% and reproducible. Under these conditions, it is possible to determine 100 ppM of P to ±6%, 100 ppM of Si to ±4%, and 250 ppM of Al to ± 15%. (France)

16 (RLO-2221-T-3-3) ROLE OF PAPER MILL ADDITIVES AS POTENTIAL STREAM POLLUTANTS: DEVELOPMENT OF NUCLEAR TECHNIQUES. Third Annual Report, June 1, 1972 – May 31, 1973. *Sheppard, J. C.* (Washington State Univ., Pullman, Research Div.). 1 Feb 1973. Contract AT(45-1)-2221. 36p. Dep. NTIS $4.00.

Distributions of TiO_2, ZnO, conductive resin, and Quilon were determined by the microtome sectioning–neutron activation analysis technique. The conductive resin study also involved the tagging of the conductive resin with $IrCl_6^=$ ion. This series of studies determined the distribution of the conductive resin for the first time, revealed previously unknown TiO_2 distributions, and showed an unexpected distribution for Quilon. Preliminary experiments were performed to demonstrate the potential of Rutherford scattering as a means of determining the distribution and nature of additives in paper. These experiments indicated that significant information can be obtained by this technique. The distribution and path of TiO_2 in a Pacific Northwest paper mill were determined and demonstrated the advantages of neutron activation as a means of analyzing process solutions containing low concentrations of titanium. Zinc in paper from a Pacific Northwest paper mill was analyzed by neutron activation to determine if zinc originally in the clay filler remained with the clay or was chemically removed to the plant effluent. The zinc was retained by the clay. It was found that a 30 Ci ^{241}Am–Be source could be used for rapid analysis of the clay filler content of paper but did not offer any significant advantage over the conventional ashing technique. (auth)

17 INVESTIGATION OF THE INTERACTION OF CHLOROPLATINATE(II) WITH DEOXYRIBONUCLEIC ACID BY ACTIVATION ANALYSIS. *Abashin, E. G.; Geidarova, E. T.; Gorshkov, V. V.; Moshkovskii, Yu. Sh.; Smakhtin, L. A.* (Inst. of Chemical Physics, Moscow). Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 8, 1137-1138(Aug 1972).

Translated from Zh. Fiz. Khim.; 46: No. 8, 1984-1986(Aug 1972).

A neutron activation method for the determination of platinum bound to DNA, based on the isolation of the platinum–thioxine complex by extraction with chloroform, was developed. The kinetic curves obtained for the binding of platinum by DNA preparations indicates a topochemical mechanism for the reduction process. With increase of reaction temperature, the induction period becomes markedly shorter. (auth)

18 PHYSICAL METHODS OF ANALYSIS. Pierce, T. B. (Atomic Energy Research Establishment, Harwell, Eng.). J. Radioanal. Chem.; 12: No. 1, 11-21(Oct 1972).

International meeting on chemical analysis by charged particle bombardment; Namur, Belgium (6 Sep 1971).

The choice of analytical techniques for the solution of real analytical problems is governed not only by the characteristics of the individual methods, but also by the alternatives available. *The capabilities of some methods of elemental analysis are considered and compared with those of selected techniques based upon sample irradiation with charged particles.* (auth)

19 CHARGED-PARTICLE ACTIVATION ANALYSIS. Pierce, T. B. (Atomic Energy Research Establishment, Harwell, Eng.). J. Radioanal. Chem.; 12: No. 1, 23-38(Oct 1972).

International meeting on chemical analysis by charged particle bombardment; Namur, Belgium (6 Sep 1971).

Charged-particle activation analysis has been used for many years for the determination of light elements by measuring the induced radioactivity produced by charged-particle bombardment. Recently, a variety of techniques have been produced, based upon the measurement of prompt radiation which have enabled structural information, depth distributions and small-volume analyses to to be obtained in addition to gross-element analysis. These methods have greatly extended both the scope of charged-particle techniques and the range of problems to which they can be applied. (auth)

20 NON-DESTRUCTIVE ACTIVATION ANALYSIS OF SOME ELEMENTS IN STONY METEORITES BY PROTON AND BREMSSTRAHLUNG IRRADIATION. van Zelst, L. (Instituut voor Kernphysisch Onderzoek, Amsterdam). J. Radioanal. Chem.; 12: No. 1, 129-137(Oct 1972).

International meeting on chemical analysis by charged particle bombardment; Namur, Belgium (6 Sep 1971).

Proton activation was applied for the instrumental analysis of Fe, Ni, Ca, Ti, and Cr in stony meteorites. Error sources are discussed, some results are reported, and a comparison is made between this method and photon activation. (auth)

21 CARBON AND NITROGEN DETERMINATION BY ACTIVATION, USING THE NUCLEAR REACTIONS $^{12}C(\alpha,n)^{15}O$ AND $^{14}N(d,n)^{15}O$. Mayolet, F. (CEN, Saclay, France); Reimers, P.; Engelmann, C. J. Radioanal. Chem.; 12: No. 1, 115-128(Oct 1972).

International meeting on chemical analysis by charged particle bombardment; Namur, Belgium (6 Sep 1971).

The carbon and nitrogen activation curves were determined for the nuclear reactions $^{12}C(\alpha,n)^{15}O$ and $^{14}N(d,n)^{15}O$, within the limits of the following maximum energies: 40 MeV for α-particles, and 21 MeV for deuterons. Inferences are made concerning the potential possibilities of these activation methods, from the sensitivity aspects, for the determination of carbon and nitrogen, with reference to the problem of the main interferences which have also been studied experimentally. The chemical separation process used to isolate ^{15}O after irradiation is described. Concrete examples of carbon and nitrogen determinations by these methods are given. (auth)

22 QUANTITATIVE ANALYSIS OF ALUMINUM BY PROMPT NUCLEAR REACTIONS. Deconninck, G.; Demortier, G. (Univ., Namur, Belg.). J. Radioanal. Chem.; 12: No. 1, 189-208(Oct 1972).

International meeting on chemical analysis by charged particle bombardment; Namur, Belgium (6 Sep 1971).

The sample is bombarded with fast protons and the resulting γ-rays are analyzed by the Ge(Li) technique. The high selectivity of these detectors allows identification of the nuclei responsible for the γ-ray emission. A careful analysis was made of the different nuclear reactions involved in the production of γ-rays in the bombardment of aluminium. Four γ-rays were observed with sufficient intensities for rapid determination: 843 keV, 1013 keV, 1368 keV, and 1778 keV. Thick-target excitation yields are presented and discussed in view of their use in analysis. A complete tabulation of these reactions is also presented. The method allows the determination of the aluminium concentration in every solid matrix in the 100 ppM range. In some cases concentrations as low as 10 ppM can be observed. All these determinations are quantitative. Lower concentrations can be detected qualitatively. Examples of the application of the method to different substances are the following: stainless steel, inorganic compounds, crystals, evaporated layers, etc. The resonance pattern observed in the intensity curves can be used to measure the homogeneity and the thickness of thin layers containing aluminium (0.2 to 4 μm). In most cases the method can be considered nondestructive and there is no residual radioactivity. Analysis of a sample of a total weight not exceeding 0.1 mg can be achieved. (auth)

23 PROMPT GAMMA RAYS FROM TRITON-INDUCED REACTIONS ON OXYGEN AND THEIR USE FOR ANALYSIS. Peisach, M. (CEN de Saclay, Gif-sur-Yvette, France). J. Radioanal. Chem.; 12: No. 1, 251-259(Oct 1972).

International meeting on chemical analysis by charged particle bombardment; Namur, Belgium (6 Sep 1971).

Triton-induced reactions on oxygen were studied with a view to using the prompt γ-rays for analytical purposes. Five γ-rays were found to be potentially useful, of which three had a high intensity, the n(1, 0), n(2, 0) and p(1, 0) γ-rays, the other two being the n(3, 0) and the unresolved pair $\alpha(1, 0) - \alpha(2, 0)$. The γ-rays are labeled according to the convention s(a, b), where s is the light prompt product and the γ-photon is emitted by de-excitation from level a to b in the heavy product nucleus. The method had a relative precision of 2 to 3.5% for surface oxygen concentrations from 50 to 3 μg/cm². The sensitivity with 1,900 keV tritons was 0.13 μg/cm² on surfaces of steel or copper which did not yield interfering γ-rays, but 0.45 μg/cm² on aluminium where interfering γ-rays were emitted. (auth)

24 ANALYTICAL APPLICATION OF THE DIRECT OBSERVATION OF NUCLEAR REACTIONS INDUCED BY LOW-ENERGY PROTONS AND LEADING TO THE EMISSION OF γ-PHOTONS, WHICH ARE MEASURED. Golicheff, L.; Loeuillet, M.; Engelmann, C. (CEN, Saclay, France). J. Radioanal. Chem.; 12: No. 1, 233-250(Oct 1972).

The yields of the most characteristic photon emissions of the elements Li, Be, B, C, N, O, and F were plotted for incident proton energies ranging from 400 keV to 1500 keV. The possibilities offered by the use of this direct observation method to measure the superficial concentrations of these elements are deduced. The sensitivities intrinsically obtainable with the experimental device are given and the practical possibilities of the method are discussed, allowance being made for the simultaneous presence of several of the above elements. (auth)

25 QUANTITATIVE ANALYSIS OF PHOSPHORUS BY (p,γ) REACTIONS. Demortier, G.; Bodart, F. (Univ., Namur, Belg.). J. Radioanal. Chem.; 12: No. 1, 209-219(Oct 1972).

International meeting on chemical analysis by charged particle bombardment; Namur, Belgium (6 Sep 1971).

Measured values of the intensities of characteristic γ-rays emitted under the bombardment of protons on a thick target of phosphorus are tabulated. The intensity of each characteristic γ-ray is measured and used for quantitative analysis of phosphorus in any sample with a sensitivity of 50 to 1000 ppM. (auth)

26 RADIOACTIVATION ANALYSIS OF IRON IN YOUNG DEVELOPING CHICK BLASTODERMS USING $^{56}Fe(p,2n)^{55}Co$ AND A Ge(Li) DETECTOR FOR GAMMA-RAY SPECTROMETRY. Bonnet-Masimbert, O.; Prenat, M. F. (Institut des Sciences Nucleaires, Grenoble, France). J. Radioanal. Chem.; 12: No. 1, 151-155(Oct 1972).

International meeting on chemical analysis by charged particle bombardment; Namur, Belgium (6 Sep 1971).

A method was developed for assay of iron based on its radioactivation by means of a 26 MeV proton bombardment. The technique was sensitive to 20 to 100 ppM of iron diluted by large excesses of extraneous proteins and major or trace mineral elements. It could be shown that the incorporation of iron in one blastodisc, from the stage of 1 somite to that of 16 somites, is strictly parallel with the weight increase of its ashes. (auth)

27 QUANTITATIVE ANALYSIS BY (p,x) AND (p,γ) REACTIONS AT LOW ENERGIES. Deconninck, G. (Univ., Namur, Belgium). J. Radioanal. Chem.; 12: No. 1, 157-169(Oct 1972).

International meeting on chemical analysis by charged particle bombardment; Namur, Belgium (6 Sep 1971).

Production of atomic x-rays and nuclear γ-rays by bombardment with 0 to 3 MeV protons of thick targets is described. In the case of low-Z atomic x-rays, the absorption in the target is very large, while in the case of K x-rays from high-Z atoms or for γ-rays, this phenomenon is negligible. Both of these reactions can be used for analysis of elements from F to U, and the sensitivities and the accuracies of the determinations are discussed. A table is given showing the γ-ray energies observed in 11 substances and the limits of sensitivity. (auth)

28 DEUTERON ACTIVATION ANALYSIS OF GEOLOGICAL SAMPLES. Pretorius, R.; Odendaal, F.; Peisach, M. (Southern Universities Nuclear Inst., Faure, South Africa). J. Radioanal. Chem.; 12: No. 1, 139-149(Oct 1972).

International meeting on chemical analysis by charged particle bombardment; Namur, Belgium (6 Sep 1971).

Deuteron activation was found to be suitable for analysing geological samples, as no interfering activities are formed from

oxygen, silicon and aluminium, which together make up more than 80% by weight of the earth's crust. To test the applicability of this method to geological samples, the mineral tourmaline was activated with 5.5 MeV deuterons obtained from the 6 MV van de Graaff accelerator at the Southern Universities Nuclear Institute. The induced activities were measured and analysed by gamma-ray spectrometry and the elements Al, Mg, B, Mn, Na, Fe and Li could readily be determined. (auth)

29 SECONDARY IONIC EMISSION AND NUCLEAR REACTIONS TO DETERMINE THE PARAMETERS IN THE MANUFACTURE OF A PLANAR TRANSISTOR. Monnier, J.; Hilleret, H.; Ligeon, E.; Quoirin, J. B. (CEN, Grenoble, France). J. Radioanal. Chem.; 12: No. 1, 363-366(Oct 1972).

International meeting on chemical analysis by charged particle bombardment; Namur, Belgium (6 Sep 1971).

Several microanalytical problems arising in the study of the manufacture of a planar bipolar transistor are solved using the techniques of nuclear reactions and secondary ionic emission analysis. The results obtained permit a comparison of the possibilities of the two methods. (auth)

30 NUCLEAR REACTION ANALYSIS OF BORON AND OXYGEN IN SILICON. Ligeon, E.; Bontemps, A. (CEN, Grenoble, France). J. Radioanal. Chem.; 12: No. 1, 335-351(Oct 1972).

International meeting on chemical analysis by charged particle bombardment; Namur, Belgium (6 Sep 1971).

The main characteristics of analysis by the nuclear method at low energy are summarized. The experimental set-up, and especially the target chamber arrangement are shown. Nuclear analyses of boron and oxygen in a silicon substrate are presented; sensitivity, accuracy and competing reactions were studied. The analysis of boron and oxygen is possible, although these elements give interfering reactions. Results concerning homogeneity in the sample surface (for diffused or implanted boron), a diffusion study (SiO_2–Si exchange) and profile measurements are presented. (auth)

31 OXYGEN, CARBON, AND NITROGEN DETERMINATION BY MEANS OF NUCLEAR REACTIONS. Weber, G.; Quaglia, L. (Univ., Liege). J. Radioanal. Chem.; 12: No. 1, 323-333(Oct 1972).

International meeting on chemical analysis by charged particle bombardment; Namur, Belgium (6 Sep 1971).

After a brief account of the general principles of the method, a description is given of some aspects of the problems which have been investigated in detail: behaviour of targets under ion-bombardment, determination of oxygen, carbon, and nitrogen at the surface of metallic targets, and determination of carbon and nitrogen in tantalum layers metallized on glass. (auth)

32 DETERMINATION OF ^{10}B BY PROMPT PROTON SPECTROMETRY. Olivier, C. (Univ. of Stellenbosch, South Africa); Peisach, M. J. Radioanal. Chem.; 12: No. 1, 313-322(Oct 1972).

International meeting on chemical analysis by charged particle bombardment; Namur, Belgium (6 Sep 1971).

Boron was analysed in ore and glass samples by prompt proton spectrometry, using deuterons of 2.7 MeV to coincide with a region where the excitation function of the $^{10}B(d,p)^{11}B$ reaction did not vary appreciably with energy. Targets of approximately 300 $\mu g/cm^2$ thick of powdered samples were prepared by centrifugation. Concentrations down to 0.2% were determined. Possible interference by other elements, particularly nitrogen, magnesium and titanium, was investigated. (auth)

33 ISOTOPIC ANALYSIS OF LITHIUM BY PROMPT ALPHA MEASUREMENT DURING DEUTERON IRRADIATION. Pretorius, R. (Southern Universities Nuclear Inst., Faure, South Africa); Coetzee, P. J. Radioanal. Chem.; 12: No. 1, 301-311(Oct 1972).

Charged particle spectrometry was used to determine the isotopic concentration of lithium in lithium fluoride targets irradiated with a deuteron beam of 4.0 MeV. Alpha particles emitted by the $^6Li(d,\alpha)^4He$ and $^7Li(d,\alpha)^5He$ reactions were used as a measure of ^6Li and ^7Li, respectively. From the $^6Li/^7Li$ α-count ratio the isotopic concentration of ^6Li was determined for isotopic concentrations over the range 7.42 (natural) to about 30 atom% ^6Li, with a relative standard deviation of ±4.1%. Alpha particles from the $^{19}F(d,\alpha)^{17}O$ reaction could also be measured as an internal standard, extending the measurements from natural to 100 atom% ^6Li and giving a relative standard deviation of ±1.9%. The effect of target thickness on the accuracy of the determinations was investigated. (auth)

34 GEOMETRICAL FACTORS IN THE NEUTRON ACTIVATION ANALYSIS OF ARCHAEOLOGICAL SPECIMENS. Warren, S. E. (Univ. of Bradford, Eng.). Archaeometry; 15: No. 1, 115-122(Feb 1973).

In the neutron activation analysis of museum specimens, for which sampling is not permitted, corrections must be applied to measured activities to take into account the sample shape and its position relative to the detector. Correction factors are derived for samples of cylindrical shape such as segmented faience beads and a model technique is suggested for those of irregular shape such as flint and obsidian implements. These techniques used in gamma spectrometry with lithium-drifted germanium detectors enable elemental concentrations to be determined from the measured count rates. (auth)

35 DETERMINATION OF GOLD IN GERMANIUM BY NEUTRON ACTIVATION ANALYSIS. Gijbels, R. (State Univ., Ghent). Talanta; 20: No. 3, 346-348(Mar 1973).

Gold was determined in gold-doped germanium by neutron activation analysis. The irradiated samples were dissolved in aqua regia, in the presence of gold carrier. The matrix activity was eliminated by distillation, and gold precipitated in the residue with hydroquinone. The gold fraction was essentially radiochemically pure. For a neutron dose of $5 \times 10^{16} n/cm^2$, a sensitivity of 1 ppM Au can be obtained with a 2.4-g sample. The samples investigated contained from 24 to 36 ppM Au. (auth)

36 MEASUREMENT OF PHOSPHORUS IN HUMAN BONE USING RADIOACTIVE NEUTRON SOURCES. A Technique for Partial Body in Vivo Activation Analysis. Boddy, K.; Glaros, D. (Scottish Research Reactor Centre, East Kilbride). Int. J. Appl. Radiat. Isotop.; 24: No. 3, 179-182(Mar 1973).

Pilot experiments were carried out to assess the feasibility and validity of the use of radioactive neutron sources for partial in vivo activation analysis in the clinical environment. Such sources would offer the advantage of compactness while requiring minimum maintenance or skilled attention. Relatively low capital cost is coupled with reduced shielding and operating costs. Using a 1 Ci ^{241}Am-Be source, the reproducibility for measuring phosphorus in the lower leg and the hand with various geometries was measured and is tabulated. (UK)

37 TWO INSTRUMENTS FOR ACTIVATION ANALYSIS OF SOLUTIONS BY A DILUTION METHOD. Louwrier, P. W. F.; Aten, A. H. W.; van Hooidonk, J. (Instituut voor Kernphysisch Onderzoek, Amsterdam). Int. J. Appl. Radiat. Isotop.; 24: No. 3, 147-151(Mar 1973).

Two methods are described for the determination of the concentration of a main component in an aqueous solution by activation with a radioactive neutron source. (auth)

38 CHARGED PARTICLE AND PHOTON ACTIVATION ANALYSIS OF OXYGEN IN ALUMINUM. Vialatte, B. (CEN de Saclay, Gif-sur-Yvette, France). Compt. Rend., Ser. C; 275: No. 23, 1407-1409(6 Dec 1972). (In French).

Various methods of charged-particle activation analysis were studied. The appropriate method was chosen to determine oxygen in aluminium samples. The oxygen content of the Al is very small (0.5 to $<0.05 \cdot 10^{-6}$ depending on the manufacturing techniques used). Only activation analysis methods permitting determinations to be performed beyond the surface oxide film give true results for bulk samples. (France)

39 ACTIVATION ANALYSIS METHODS. Engelmann, C. (CEN de Saclay, Gif-sur-Yvette, France). J. Microscop.; 15: No. 3, 263-267(Dec 1972). (In French).

The principles and the advantages of activation analysis are presented. Tables are given concerning: the principal possibilities of activation analysis (different types of nuclear reaction and their applicabilities, order of magnitude of the quantities determinable); the activation procedure used to determine oxygen; some applications of activation analysis using γ photon or charged particles (determination of B, C, O_2, D_2, and F_2). (France)

40 PRACTICAL EXPERIENCE WITH NEUTRON ACTIVATION ANALYSIS OF WATER. Schmitz, J.; Schneider, J.; Vogg, H. (Gas–Wasserfach, Wasser–Abwasser; 113: No. 7, 318-324(1972). (In German). (KFK–1533).

Samples from eight different water spots within the seepage area of the Danube river were studied. The samples were freeze-dried, activated using three different methods, and measured with a germanium-lithium detector connected to a 4000 channel analyzer. Activation with fast neutrons of 14 MeV showed mainly macro-components of the water, such as N, Na, Mg, Al, Si, Cl, K, Ca, Sr, and Ba. Short-term activation with reactor neutrons showed predominantly Na, Mg, Cl, K, Mn, Br, Sr, and I. Long-term activation with reactor neutrons detected Na, Ca, Sc, Cr, Fe, Co, Zn, Se, Br, Rb, Sr, Cs, Ba, La, Ce, Yb, Hf, Au, Hg, Th, and U. Seepage studies with lanthanum were also performed. (HBG)

41 CHLORIDES OF TELLURIUM. I. On the Existence of Solid Tellurium Dichloride. Christensen, G. C.; Alstad, J. (Univ. of Oslo). Radiochem. Radioanal. Lett.; 13: No. 4, 227-234(27 Apr 1973).

A series of analyses of elementary tellurium, tellurium tetrachloride, and tellurium dichloride were performed by means of laser Raman, infrared, and x-ray techniques, and also gravimetric and neutron activation analysis. The results obtained indicate the non-existence of solid tellurium dichloride. (auth)

42 ACCELERATED NEUTRON ACTIVATION DETERMINATION OF STRONTIUM IN NATURAL WATERS. Abdullaev, A. A.; Khakimov, S.; Khasanov, A. S. Sov. Radiochem. (Engl. Transl.); 14: No. 3, 509-510(1972).

Translated from Radiokhimiya; 14: No. 3, 496-497(1972).

A method is described for determining strontium in natural water by neutron activation and γ spectroscopy of ^{87m}Sr after extraction with 8-hydroxyquinoline in chloroform. The sensitivity of the method is 1×10^{-7} g/ml with a relative standard deviation of 5 to 15%. The output of the method is 25 to 30 samples in a seven-hour working day, calculated on the basis of one analysis. (DHM)

43 SIMULTANEOUS MULTI-ELEMENT GROUP ACTIVATION ANALYSIS STUDIES IN TERRESTRIAL ROCKS AND STONY METEORITES. Case, D. R. Lafayette, IN; Purdue Univ. (1969). 215p. University Microfilms Order No. 73-6136.

Thesis (Ph. D.).

A versatile adaptation of neutron activation analysis was developed for the determination of trace elements in chemical groups separated from irradiated and dissolved samples. Aqueous portions of the separated groups were subjected to gamma spectrometry using an 11.3 cm^3 Ge(Li) detector. Chemical recoveries were determined by gamma spectrometry of reirradiated aliquots of the separated groups. Data analysis was accomplished using a computer program (called MARS) that applied corrections for nonlinearity of the spectrometer, and gain and baseline shifts to all spectra prior to an iterative least squares determination of component radioactivities. The validity of the technique is demonstrated for the determination of As, Hg, Os, Re, Sb, and Se (separated by distillation) in synthetic samples, the eight U.S.G.S. Standard Rocks, and in C-, H-, L-, and LL-group chondrites. The results obtained for 14 carbonaceous and 5 equilibrated ordinary chondrites indicate that Re and Os are undepleted elements; As, Sb, and Se are normally depleted elements; and Hg is a strongly depleted element in meteorites. The Hg contents in 12 unequilibrated ordinary chondrites decrease almost exponentially with increasing degree of equilibration, while the As, Re, Sb, and Se contents exhibit no trend. Furthermore, the Hg contents in these meteorites correlate well with both C and Bi. (Diss. Abstr. Int., B)

44 TRACE ELEMENT DETERMINATIONS IN U.S.G.S. STANDARD ROCKS AND CHONDRITES BY A NOVEL ADAPTATION OF NEUTRON ACTIVATION ANALYSIS. Laul, J. C. Lafayette, IN; Purdue Univ. (1970). 243p. University Microfilms Order No. 73-6143.

Thesis (Ph. D.).

A novel adaptation of neutron activation analysis was developed for the determination of trace elements. This technique was used for the determination of Au, Ga, Mo, Sb, Te, Bi, and Tl in a synthetic sample in duplicate samples, of the eight U.S.G.S. standard rocks and in chondrites of various groups. The abundance ratios of the ordinary to Type I carbonaceous chondrites (C1) for the above elements except Au agree with the depletion assignments made previously. The ratios of the carbonaceous chondrite type C1:C2:C3 relative to C1 are nearly unity for the undepleted elements Au and Mo and quite similar to the predicted mean ratios of 1:0.55:0.32 for normally depletion Ga and Sb and strongly depleted Te, Bi, and Tl. The C1 analyses indicate cosmic abundances in units of atoms/10^6 Si atoms for Au, Ga, Mo, Sb, Te, Bi, and Tl of 0.190 ± 0.015, 36.3 ± 1.7, 3.93 ± 0.2, 0.45 ± 0.07, 15.2 ± 4.6, 0.143 ± 0.01, and 0.094 ± 0.01 respectively. In the C3 chondrites, the atomic abundances of the strongly depleted elements Te, Bi, and Tl appear in general to be higher in the Vigarano subtype than in the Ornans subtype. In the unequilibrated Ordinary chondrites, the atomic abundances of Au, Mo, Ga, and Sb in the H-, L-, and LL- groups are constant with respect to the percent mean deviation of Fe^{++} in Olivine (PMD). The strongly depleted elements Bi and Tl decrease nearly exponentially with decreasing PMD (or increasing equilibration). Bismuth seems to be underabundant in at the most unequilibrated member of the H-, L-, and LL- groups studied. The Bi results correlate well with C. The determination in the dark and light phases of the Fayetteville equilibrated ordinary chondrite indicate that Au, Mo, Ga, and Sb are constant in both whereas Bi and Tl are higher in the dark than in the light phase. (Diss. Abstr. Int., B)

45 PARTICLE SIZE DISTRIBUTIONS OF TRACE ELEMENTS IN POLLUTION AEROSOLS. Nifong, G. D.; Boettner, E. A.; Winchester, J. W. (Univ. of Michigan, Ann Arbor). Amer. Ind. Hyg. Ass. J.; 33: No. 9, 569-575(Sep 1972).

Samples of industrial community atmospheres were collected by cascade impactor, and the particle size fractions were analyzed for 25 elements. Dispersive, condensation, and natural sources were thus indicated for various metals. Some elements (Na, K, Br, Cl) rapidly approach a "Junge distribution;" others (Fe, Cr, Ca, Al) do not. The data suggest that primary particle size distributions determined by source processes may be modified by coagulation and sedimentation within the urban area studied. Gravitational settling and turbulent impactation are indicated as important mechanisms of aerosol removal by fallout. Elemental content of particulate size fractions can serve to establish natural tracers for certain emission processes. (auth)

46 ACTIVATION ANALYSIS SYSTEM USING A 14-MeV NEUTRON GENERATOR TUBE. Fujii, I.; Kamei, H.; Onodera, K. (Tokyo Shibaura Electric Co. Ltd., Kawasaki, Japan). Proc. Jap. Conf. Radioisotop.; No. 10, 380-382(Apr 1972). (In Japanese).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

The apparatus was developed for industrial use. A Philips 18602 sealed-off neutron generator tube was adopted. An ion source is of the PIG type. The D ions produced were accelerated to 150 keV in one step. For the analysis, a side-pole-type scintillator was used to improve the automatic sample ejection mechanism. Switching of the ion source was done mechanically with a beam shutter. A CR monitor was constructed by electronic circuits. According to results of a 300-hr test the neutron output was very stable, and adjustment was almost unnecessary. The neutron irradiation area was about 20 cm^2. The sensitivity was 200 to 500 Cl/mg. The evacuation system was not necessary, and the neutron source was long-lived. Target life was also very long. Stability, reproducibility, ease of operation, and maintenance cost were excellent. Shielding can be made simple because the neutron source is small in size. About 2000 samples can be analyzed with one target of 500-hr life. The analysis cost is less than that with conventional apparatuses. (Japan)

47 COMPARISON OF GAMMA-RAY RESONANCE SCATTERING TECHNIQUES FOR BOREHOLE ANALYSIS. Sowerby, B. D. (Australian Atomic Energy Commission, Sutherland). Nucl. Instrum. Methods; 108: No. 2, 317-326(1973).

The various γ-ray resonance scattering methods have been studied for possible applications to in-situ borehole analysis. The methods studied use (1) radioisotope sources for which recoil energy losses are compensated by mechanical motion, heating or recoil from preceding decay (in solid, liquid, and gaseous sources), (2) nuclear reactions induced by α-particles or accelerators, (3) bremsstrahlung and Compton scatter radiation and (4) neutron capture γ-rays. The techniques most suited to borehole analysis are those using radioisotope sources. Of these techniques, the gaseous source method is the most promising. The other methods are not suitable for borehole analysis because of either low resonance count rates, the need to use accelerators or low signal to background ratios. (auth)

48 NUCLIDE ANALYSIS BY PROMPT RADIATION SPECTROMETRY. Okano, M. (Inst. of Physical and Chemical Research, Wako, Japan). Proc. Jap. Conf. Radioisotop.; No. 10, 261-263(Apr 1972). (In Japanese).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

Fundamental aspects and examples of nuclide analysis by prompt radiation spectrometry are reviewed. Cyclotron-accelerated particles and radiation emitted from radioisotopes were used for the excitation and nuclear reaction of sample material. As the prompt radiation, characteristic x rays from the excited material, γ rays due to Coulomb excitation, and γ rays due to the nuclear reaction were used. For the detection of the radiation, the semiconductor γ spectrometer was used. As the example, the γ spectrum of urea bombarded by 8-MeV protons was measured with a Ge(Li) pair spectrometer. Finally, as the future prospect of the prompt radiation spectrometry, the following five areas are discussed: analysis of the microscopic portion by the use of focused accelerated particles; x-ray fluorescence analysis; analysis of organic compounds by Coulomb excitation; analysis of the γ ray due to neutron capture; and analysis by intermittent irradiation. (Japan)

49 ANALYSIS OF NICKEL CONCENTRATES ACCORDING TO SHORT-LIVED ISOTOPES. Dutov, A. G.; Leushkina, G. V.; Lobanov, E. M.; Matveeva, N. P. Ind. Lab. (USSR) (Engl. Transl.); 38: No. 6, 844-845(Jun 1972).

Translated from Zavod. Lab.; 38: No. 6, 663-664(Jun 1972).

A neutron activation method is described for determining Se, Sc, and Ag in Ni concentrates using the short-lived isotopes ^{77m}Se($T_{\frac{1}{2}}$ = 17.5 s), ^{46m}Sm($T_{\frac{1}{2}}$ = 19.5 s), and ^{110}Ag($T_{\frac{1}{2}}$ = 24 s). The quantitative determination of Al and Mg was performed according to the background spectra of the samples. Sensitivity of the determination is 1.6×10^{-7} g for Se, 1×10^{-8} g for Sc, 2×10^{-7} g for Ag, 6×10^{-5} g for Al, and 2×10^{-4} g for Mg. (DHM)

Chemical and Spectral Procedures

Refer also to abstracts 191, 386, 415, 763, 812, and 1573.

50 (AECL-4446) SPECTROFLUORIMETRIC DETERMINATION OF BORON WITH CARMINIC ACID IN NEUTRAL SOLUTIONS. Bruce, T.; Ashley, R. W. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Feb 1973. 14p. Dep. NTIS (U. S. Sales Only) $3.00. AECL $0.50.

A method is described for determining boron spectrofluorimetrically with carminic acid in buffered neutral solutions. Solutions are excited at 476 mμ and fluorescence intensities are measured at 585 nm. Maximum intensity occurs at about pH 7 and is directly proportional to boron concentration at least up to 2.5 μg B/ml. Standard deviation is ±0.03 μg/ml. Other ions which form fluorescent complexes with carminic acid must be removed or masked. (auth)

51 (CEA-R-4433) DETERMINATION OF TIN, MOLYBDENUM, NIOBIUM, TANTALUM, TITANIUM, TUNGSTEN, VANADIUM, AND ZIRCONIUM IMPURITIES IN URANIUM. Separation of Uranium by Cupferron and Spectrographic Determination in a Iron Matrix. Heres, A. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Jan 1973. 17p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

Tin, molybdenum, niobium, tantalum, titanium, tungsten, vanadium, and zirconium present at ppM level in uranium compounds are separated from uranium by cupferron after addition of iron for use as matrix for spectrographic analysis and gallium for use as internal standard. For 10 mg of iron added to 2 g of uranium, the detection limit is about 0.5 ppM in uranium. The relative standard deviation is about 5 to 10%. (auth)

52 (EUR-[illegible]) AUTOMATIC DEVICE FOR SEPARATION OF URANIUM AND PLUTONIUM FROM SPENT NUCLEAR FUEL BY ION EXCHANGERS FOR MASS SPECTROMETRY. Bol, D.; Brandalise, B.; Bier, A.; De Rossi, M.; Koch, L. (European Inst. for Transuranium Elements, Karlsruhe (West Germany)). Mar 1973. 18p. (In German). Dep. NTIS (U. S. Sales Only) $3.00.

An automatic device was developed which separates uranium and plutonium from nuclear fuel for their isotope analysis. Up to six samples can be separated by ion exchangers simultaneously. The addition of wash and eluent as well as the collection of up to five fractions per column is automated. The volumes of wash, eluent and fractions can be chosen individually for each column. The filling of the column is controlled by a light barrier. Pumps, valves and fraction collectors are operated by a control unit based on the digital technique. (auth)

53 (JAPFNR-92) ANALYTICAL METHODS OF CHLORINE IN SODIUM. (Japan Atomic Energy Research Inst., Tokai). Mar 1972. 54p. Dep. NTIS (U. S. Sales Only) $5.45.

For Power Reactor and Nuclear Fuel Development Corp., Tokai, Japan.

Chlorine occurs as an impurity in sodium as a result of the commercial production of sodium metal by the Downs process. In order to determine chlorine in sodium, three methods, i.e., a potentiometric titration with mercurous nitrate, a coulometric titration with mercury, and an extraction-photometric method using mercury(II)-diphenylcarbazone complex were investigated. Sodium containing more than 10 ppM chlorine can be analyzed by the potentiometric or coulometric titration without prior separation, and the limit of detection in the extraction-photometric method without separation was about 5 ppM chlorine. Sodium that contains less than 10 ppM chlorine can be analyzed by potentiometric or coulometric titration after separation of chloride by vacuum distillation technique. (auth)

54 (NIM-970) DETERMINATION, BY ATOMIC-ABSORPTION SPECTROPHOTOMETRY, OF PLATINUM, PALLADIUM, RHODIUM, RUTHENIUM, GOLD, SILVER, AND LEAD, IN PRILLS. Laboratory Method No. 78/4. Steele, T. W.; Mallett, R. C.; Pearton, D. C. G.; Ring, E. J. (National Inst. for Metallurgy, Johannesburg (South Africa)). 5 Jun 1972. 9p. Dep. NTIS (U. S. Sales Only) $3.00.

An atomic absorption spectrophotometric method for determining Pt, Pa, Rh, Ru, Au, Ag, and Pb in prills is described in which the prill is dissolved in aqua regia and uranium is added to serve as a releasing agent and to remove mutual-interference effects. (DHM)

55 (NIM-1086) DETERMINATION, BY ATOMIC-ABSORPTION SPECTROSCOPY, OF PLATINUM, PALLADIUM, RHODIUM, RUTHENIUM, AND GOLD IN THE PRESENCE OF BASE METALS. Laboratory Method No. 78/8. Steele, T. W.; Mallett, R. C.; Pearton, D. C. G.; Ring, E. J. (National Inst. for Metallurgy, Johannesburg (South Africa)). 30 Sep 1970. 11p. Dep. NTIS (U. S. Sales Only) $3.00.

A method for the determination, by atomic-absorption spectrophotometry, of platinum, palladium, rhodium, ruthenium, and gold is described. Vanadium in a perchloric acid medium is used as a releasing agent for the removal of interferences. Tin, magnesium, chromium, cobalt, nickel, aluminium, selenium, tellurium, calcium, copper, or sodium, in amounts below 5 g/l, and gold in an amount below 1 g/l, do not interfere. Silver and lead in amounts above 0.02 g/l may cause some loss of noble metals because of occlusion in the chloride precipitate formed. SO_4^{2-} above 1.5 g/l may cause an interference, and iron may cause a loss of gold owing to the reduction of this noble metal. The method is rapid, since all the noble metals can be measured in one solution, and is suitable for the analysis of solutions resulting from the nickel sulfide or tin collection procedures. Coefficients of variation for all the noble metals are less than 1½%. (auth)

56 GRAVIMETRIC DETERMINATION OF ZIRCONIUM WITH 1-NAPHTHYLACETIC ACID. Part VIII. Analytical Aspects of Some Organic Acids. Pande, C. S.; Misra, G. N. (Lucknow Univ., India). Z. Anal. Chem.; 262: No. 5, 365(1972).

The composition of the Zr–1-naphthylacetic acid compound was found to be 1:1. SO_4^{2-} ions do not interfere up to a ratio of $ZrO_2:SO_4^{2-} = 1:3$. The following cations are not precipitated Ca^{2+}, Ba^{2+}, Sr^{2+}, Zn^{2+}, Hg^{2+}, Al^{3+}, Th^{4+}, Mn^{2+}, Fe^{3+}, Co^{2+}, Ni^{2+}, $(UO_2)^{2+}$. $(V_2O_4)^{2+}$ and Co^{3+} are coprecipitated with Zr, yet a double precipitation overcomes this difficulty. The determination is not possible in the presence of Sn^{2+}, Ti^{4+}, and Be^{2+} because of hydrolysis. Zirconium can be determined in the range of 0.12 to 0.002 g with errors up to ±0.0004 g. (DHM)

57 CHEMICAL ANALYSIS THROUGH ATOMIC IONOLUMINESCENCE. Meriaux, J. P.; Goutte, R.; Guillaud, C. (Institut National des Sciences Appliquees, Lyon). J. Radioanal. Chem.; 12: No. 1, 53-57(Oct 1972).

International meeting on chemical analysis by charged particle bombardment; Namur, Belgium (6 Sep 1971).

An account is given of the principle of optical microanalysis of the surface of a metallic or insulating solid through atomic ionoluminescence. Essentially, this method involves bombarding the surface to be studied with high-velocity positive ions, and recording the local emission of light resulting from the de-excitation of the pulverized atoms on the surface of the target. Two original and complementary instruments are described: an optical microanalyser and an ionprobe microanalyser; examples of possible applications are given, followed by a discussion of the performances and potentials of these systems, which are open to still further refinements. (auth)

58 DETERMINATION OF CERTAIN ELEMENTS ADDED TO FEEDS. Amati, A.; Minguzzi, A. (Univ., Bologna). Ind. Agr.; 8: No. 7-12, 249-257(1970). (In Italian).

A method is proposed for the determination of Fe, Cu, Zn, Mn, Co, and iodine in animal and poultry feeds. Dry the sample (5-g of a pre-mix; 50 to 100 g of a complete feed) for 2 hr at 130°C and stir it for 5 min. with 50 or 100 ml, respectively, of CCl_4. Centrifuge, remove the solution, resuspend the solid in CCl_4, and filter. Boil the solid residue with HCl (1 : 1) (50 ml) for 15 min. in a Kjeldahl flask, add active carbon (500 mg), dilute to 100 ml, and filter. Determine the metals by atomic-absorption spectrophotometry (air-acetylene flame) with use of standards prepared from iron, zinc, or cobalt dissolved in HCl, copper dissolved in HNO_3, and MnO_2 dissolved in HCl. Determine iodine by the method of alkaline fusion and titration with 0.005N-$Na_2S_2O_3$. Alternatively, determine the metals colorimetrically: Fe with 1,10-phenanthroline, Cu with biscyclohexanone oxalyldihydrazone, Zn with zincon, Mn as MnO_4^-, and Co with nitroso-R salt. Coefficients of variation (%) in analyses of pre-mixes and complete feeds, respectively, by atomic absorption were — Fe 1.7, 3.6; Cu 1.7, 3.3; Zn 1.0, 1.4; Mn 2.1, 2.6; Co 3.5, 9.4 (9 or 10 determinations). The colorimetric method applied to 11 complete feeds gave values for Fe, Cu, Zn, and Mn that were ≈10% lower than those by atomic absorption; corresponding deviations for Co ranged from −10.3 to +9.4%. (Anal. Abstr.)

59 SPECTROGRAPHIC ANALYSIS OF SODIUM FOR NUCLEAR USE. Ricard, J. Method. Phys. Anal.; 8: No. 1, 32-34 (Mar 1972). (In French).

The Na is converted into NaCl, of which three portions are mixed with graphite and three different internal standard elements, selected for the spectral ranges of the three exposures that are to be made on a Littrow spectrograph of high dispersion. For each of the exposures, a controlled arc source is used, with a 6-step wedge in front of the slit to provide both calibration and a long exposure-range. The impurities Ca, Ba, K, Li, and Sr are estimated by comparison with Ba or Rb lines; the remaining ones (Ag, Al, B, Cr, Cu, Fe, Mg, Mn, Mo, Ni, Pb, Si, Sn, Ti, and V) have lines to be compared with Ga lines. The analytical ranges are nearly all from 3 to 200 ppM. (Metals Abstr.)

60 LUMINESCENCE DETERMINATION OF THORIUM IN TUNGSTEN WIRE. Stolyarov, K. P.; Firyulina, V. V.; Gubaidulin, I. Z. (Leningrad State Univ.). Ind. Lab. (USSR) (Engl. Transl.); 38: No. 6, 846-847(Jun 1972).

Translated from Zavod. Lab.; 38: No. 6, 664-665(Jun 1972).

A rapid and precise method for determining thorium in tungsten wires was developed. The method involved the coprecipitation of thorium with calcium fluoride or lanthanum fluoride. Final determination was made by reacting the thorium with Complexon III and observing the disappearance of the yellow-green luminescence of the thorium complex with Morin. (ERB)

61 USE OF EMISSION SPECTROMETRY IN THE VACUUM UV FOR THE DETERMINATION OF Nb(IV) AND Nb(V) IN REFRACTORY ALLOYS AND STEELS. Malamand, F. (Office National d'Etudes et de Recherches Aerospatiales, Chatillon, France). Analusis; 1: No. 6, 420-426(Nov 1972). (In French).

The Nb(IV) 1030 A, Nb(V) 763A, and Nb(V) 774A lines were used for determinations of between 0.1 and 20% in Co or Ni based refractory alloys and some special steels. The wide range of different compositions and industrial alloys studied, together with the various reference samples, indicated the advantages of vacuum spectrometry (10^{-6}mm) in the far uv: accurate determination of high concentrations and establishment of unique analytical curves for alloys having different basic elements (Fe, Co, Ni). The Nb determination was carried out simultaneously with those of C and Cr. Other additional elements can also be determined in the far uv: Ni, Mo, Ta, Hf, W, and Fe. The reference samples supplied by the NBS, BCS, and IRSID enabled the correctness of the analytical process to be confirmed in the far uv. (France)

62 SPECTROMETRIC DETERMINATION OF NIOBIUM WITH CHLORANILIC ACID. Krizanova, M.; Reis, A.; Hainberger, L. (Catholic Univ., Rio de Janeiro). Z. Anal. Chem.; 261: No. 4-5, 400(1972). (In German).

For the spectrophotometric determination of niobium, a method was developed that used sulfuric and chloranilic acids. In 0.18 molar sulfuric acid, 0.2 to 4.0 μg niobium per milliliter could be determined at a wave length of 340 nm. The color of the complex appeared immediately and was permanently stable. Increased concentrations of sulfuric acid caused a decrease in sensitivity. The low selectivity of chloranilic acid necessitated the removal of all other metals prior to the niobium determination. Removal was accomplished through extraction with methyl isobutyl ketone. (HBG)

63 FLUORIMETRIC DETERMINATION OF EUROPIUM, TERBIUM, AND SAMARIUM. Williams, D. E. Columbia, MO; Univ. of Missouri (1972). 112p. University Microfilms Order No. 73-7107.

Thesis (Ph. D.).

Fluorimetric methods for the analysis of nanogram quantities of europium, terbium, and samarium were developed. Each method is based upon the characteristic fluorescence emission of an energy-transfer complex comprised of the rare earth ion and hexafluoroacetylacetone. The superior selectivity of the methods is a result of the energy-transfer mechanism. The development of these methods and the procedures are detailed. (Diss. Abstr. Int., B)

64 POLYPHENOLS AS REAGENTS FOR THE PHOTOMETRIC DETERMINATION OF NIOBIUM IN ALLOYS CONTAINING NONCHROMOPHORE ELEMENTS. Panarina, N. A.; Fridlyanskaya, E. I.; Yakovlev, P. Ya. (Central Scientific-Research Inst. of Ferrous Metallurgy, Moscow). Ind. Lab. (USSR) (Engl. Transl.); 38: No. 7, 995-999(Jul 1972).

Translated from Zavod. Lab.; 38: No. 7, 783-787(Jul 1972).

A differential spectrophotometric method of determining 20 to 80% Nb in the alloys Nb-Sn-Zr, Nb-Al-Zr, Nb-Al, and Nb-Sn was developed. The method is based on measurements of the light absorption of a complex of niobium with tikhromin, in a medium of ~2.5 N H_2SO_4 at a λ of 430 nm. The optimum concentration of the reference solution was determined according to the method of Bastian (ΔC = 100 μg/25 ml). The measurements were performed at 430 nm in cuvettes with l = 3 mm. The largest conditional optical density was observed using a reference solution with concentration 800 μg Nb/25 ml, which was also taken as the concentration of the reference solution. The constant factor was calculated according to the formula $\overline{F} = F \pm t_{\alpha}\frac{Sx}{\sqrt{n}}$. F = 0.576 ± 0.007 at the 0.95 probability level. The Beer-Lambert law is observed in a concentration region 400 to 1150 μg Nb in 25 ml. A content of up to 0.1% Ti is permissible. (DHM)

65 EXPRESS METHOD FOR THE PHOTOMETRIC DETERMINATION OF MOLYBDENUM AFTER EXTRACTION WITH TRIOCTYLAMINE. Ponomareva, A. A.; Agrinskaya, N. A. (Novocherkassk Polytechnic Inst., USSR). Ind. Lab (USSR) (Engl. Transl.); 38: No. 7, 1003-1004(Jul 1972).

Translated from Zavod. Lab.; 38: No. 7, 790-791(Jul 1972).

After molybdenum is extracted by TOA and separated from the interfering ions, its photometric determination was carried out directly on the extract using pyrocatechol violet. The method was applied to steel samples with a probable relative error of <1%. (DHM)

66 APPLICATION OF NICKEL AS THE INTERNAL STANDARD IN THE SPECTROGRAPHIC DETERMINATION OF LIGHT LANTHANONS. Wysocka-Lisek, J.; Kosmala, F. Ann. Univ. Mariae Curie-Sklodowska, Lublin-Pol., Sect. AA; 26-27: 159-169(1971). (In Polish).

The application of nickel as the internal standard in the quantitative determination of lanthanum and light lanthanons is described. It was shown that during the excitation on carbon electrodes the spectral lines of nickel may be used as the internal standard because their intensity is independent of the rare earth elements present in the mixture. During the excitation on copper electrodes an increase in the intensity of nickel spectral lines and a decrease in the intensity of spectral lines of the rare earth elements were observed. (auth)

67 DETERMINATION OF NATURAL ABUNDANCE CONCENTRATIONS OF CH_3D BY INFRARED SPECTROMETRY. Ritchie, R. K.; Kulawic, D. (Gulf Oil Canada Ltd., Sheridan Park, Ont.). Can. J. Spectrosc.; 17: No. 5, 150-155(Nov 1972).

A gas-phase infrared method for the accurate determination of natural abundance concentrations of CH_3D in CH_4 and natural gas was developed. The CH_3D concentration is measured from the 2200 cm^{-1} band of CH_3D which is easily observed in the spectrum of CH_4 using the 10 m pathlength of a multi-path gas cell. Calibration curves for CH_3D in N_2 and CH_4 were established. Excellent agreement was obtained between the infrared method and a combustion-reduction-mass spectrometry method for one sample of CH_4. CH_3D contents of a number of CH_4 and natural gas samples were determined, and the CH_3D/CH_4 abundance is found to be ≈500 ppM rather than the expected value of about 600 ppM. The applicability of the infrared method to other gaseous molecules is discussed. (auth)

68 ACCURATE AND PRECISE TITRIMETRIC ANALYSIS OF URANIUM IN NUCLEAR FUELS. Tolk, A. (Reactor Centrum Nederland, Petten). pp 1-7 of Analytical Chemistry of Nuclear Fuels. Vienna; International Atomic Energy Agency (1972).

From panel on the analytical chemistry of nuclear fuels; Vienna, Austria (13 Jul 1970). See STI/PUB-337; CONF-700732-.

For the accurate and precise titrimetric analysis of uranium in nuclear fuels, the uranium in the sample in general is dissolved as U(VI), reduced to U(IV) and finally titrated oxidimetrically. These oxidimetric procedures are laborious and complicated, however, and the instability of U(IV) in solution may cause complications. For this reason it is attractive to use a method whereby the U(VI) could be determined directly in the original solution by reductometric titration. It is shown that U(VI) can be titrated directly with high accuracy and precision in concentrated phosphoric acid solution. The sample is dissolved and oxidized in a mixture of orthophosphoric and nitric acids. The nitric acid fumed off, using a simple apparatus designed for this purpose; elementary oxygen present is removed by a stream of CO_2-gas and an accurately known amount of solid Fe(II)-ammonium sulphate is added for reduction of nearly all the U(VI) present. The remaining U(VI) is finally titrated with a dilute Fe(II)-standard solution. The end-point of the titration is detected following the conventional "dead-stop-end-point" procedure. For sample aliquots of about 800 mg of NBS U_3O_8-standard 950 a, certified value 99.94 ± 0.02%, a mean value of 99.947% is obtained with a coefficient of variation of 0.012% per determination. (auth)

69 METHODS USED AT THE IAEA LABORATORY IN SEIBERSDORF FOR THE DETERMINATION OF URANIUM AND PLUTONIUM FOR SAFEGUARDS PURPOSES. Malinowski, J.; Cook, G. B. (International Atomic Energy Agency, Vienna). pp 9-11 of Analytical Chemistry of Nuclear Fuels. Vienna; International Atomic Energy Agency (1972).

From panel on the analytical chemistry of nuclear fuels; Vienna, Austria (13 Jul 1970). See STI/PUB-337; CONF-700732-.

The methods used at the IAEA laboratory for the accurate determination of uranium and plutonium are briefly described. Four methods are routinely used. Details are given of the precautions to be observed if accurate results are to be obtained. (auth)

70 REVIEW OF ACCOUNTABILITY ANALYSES AT EUROCHEMIC. Bokelund, H. (Eurochemic, Mol, Belg.). pp 13-21 of Analytical Chemistry of Nuclear Fuels. Vienna; International Atomic Energy Agency (1972).

From panel on the analytical chemistry of nuclear fuels; Vienna, Austria (13 Jul 1970). See STI/PUB-337; CONF-700732-.

The experience gained with the analytical methods applied to accountability at Eurochemic is reviewed. Special emphasis is

given to input analyses by isotopic dilution mass spectrometry and uranium output is also dealt with in detail. Quality control procedures for input and output are explained. Examples of interlaboratory comparison are given. (auth)

71 RADIOCHEMICAL ANALYSIS OF NUCLEAR FUELS. Baetsle, L. H.; Demildt, A. C. (SCK/CEN, Mol, Belg.). pp 23-31 of Analytical Chemistry of Nuclear Fuels. Vienna; International Atomic Energy Agency (1972).

From panel on the analytical chemistry of nuclear fuels; Vienna, Austria (13 Jul 1970). See STI/PUB-337; CONF-700732-.

The analytical methods used at the Studiecentrum voor Kernenergie, SCK/CEN, have been developed in response to the study of the nuclear fuel cycle which has been one of the main objectives of research and development at the SKE/CEN. The methods used for the determination of uranium, plutonium, and fission products in a variety of nuclear fuels are described. Uranium is determined by reduction from U(VI) to U(III) and U(IV) using either Ti(III) or the Jones reductor, valence stabilization with sulfamic acid followed by titration. Volumetric methods for the determination of plutonium are described which utilize the reduction of Pu(VI) to Pu(IV) by an excess of ferrous sulphate followed by the determination of the excess. Some procedures for the determination of traces of plutonium are described as well as the determination of the isotopic composition of plutonium by means of alpha spectrometry. The measurement of fuel burn-up is made by assay of fission products ^{148}Nd and ^{98}Mo. Separation procedures for these fission products are described, the ^{148}Nd and ^{98}Mo being determined finally by means of neutron activation analysis. (auth)

72 DETERMINATION OF OXYGEN-TO-URANIUM RATIO IN HYPOSTOICHIOMETRIC URANIUM DIOXIDE. Tolk, A.; Lingerak, W. A.; Boerger, D. (Reactor Centrum Nederland, Petten, Netherlands). pp 45-50 of Analytical Chemistry of Nuclear Fuels. Vienna; International Atomic Energy Agency (1972).

From panel on the analytical chemistry of nuclear fuels; Vienna, Austria (13 Jul 1970). See STI/PUB-337; CONF-700732-.

A method is described for the determination of the oxygen to uranium ratio in hypostoichiometric uranium dioxide (UO_{2-y}). The method is based on the dissolution of the specimens in concentrated phosphoric acid and measurement of the volume of hydrogen released. The evolved hydrogen is separated from the stripping gas (helium) by adsorption at liquid nitrogen temperature on a suitable molecular sieve, subsequently desorbed at room temperature and determined by gas chromatography. (auth)

73 DETERMINATION OF OXYGEN-TO-URANIUM RATIO IN HYPERSTOICHIOMETRIC URANIUM DIOXIDE. Tolk, A.; Lingerak, W. A. (Reactor Centrum Nederland, Petten, Netherlands). pp 51-58 of Analytical Chemistry of Nuclear Fuels. Vienna; International Atomic Energy Agency (1972).

From panel on the analytical chemistry of nuclear fuels; Vienna, Austria (13 Jul 1970). See STI/PUB-337; CONF-700732-.

The methods available for the determination of the oxygen-to-uranium ratio in hyperstoichiometric uranium dioxide (UO_{2+x}) are reviewed. A method based on the dissolution of solid samples in concentrated phosphoric acid followed by the determination of the U(IV) so produced titrimetrically with ferrous iron is described in detail. It is shown that with adequate precautions, an accuracy and precision of 0.0001 O/U units are attainable using a sample size of about 500 mg. (auth)

74 METHODS OF ANALYSIS OF UNIRRADIATED AND IRRADIATED FUEL SAMPLES AT SGAE-SEIBERSDORF. Bildstein, H. (Reaktorzentrum, Seibersdorf, Austria). pp 67-70 of Analytical Chemistry of Nuclear Fuels. Vienna; International Atomic Energy Agency (1972).

From panel on the analytical chemistry of nuclear fuels; Vienna, Austria (13 Jul 1970). See STI/PUB-337; CONF-700732-.

The methods used for the analysis of nuclear fuel samples at the Österreichische Studiengesellschaft für Atomenergie, Reactor centre Seibersdorf, are reviewed. Methods are described for the analysis of coated fuel particles ((U, Th)C_2, UO_2, (U,Th)O_2 coated with pyrocarbon and pyrocarbon/silicon-carbide) and compacted fuels. Uranium is regularly determined after dissolution and purification by reduction with Cr(II) to U(IV) followed by titration with either Ce(IV) or Cr(VI) solutions. Thorium is determined after separation from uranium on a strongly basic ion exchange resin by titration with EDTA using xylenol orange as indicator. The measurement of burn-up by radiochemical methods (using ^{137}Cs and ^{95}Zr as fission product monitors) as well as by isotopic analysis is also discussed. The chemical analysis of fuels by nondestructive means is briefly reviewed. (auth)

75 PRECISE METHODS FOR DETERMINING PLUTONIUM AND URANIUM. Waterbury, G. R.; Metz, C. F. (Los Alamos Scientific Lab., NM). pp 71-80 of Analytical Chemistry of Nuclear Fuels. Vienna; International Atomic Energy Agency (1972).

From panel on the analytical chemistry of nuclear fuels; Vienna, Austria (13 Jul 1970). See STI/PUB-337; CONF-700732-.

Several titration methods for determining plutonium and uranium were used extensively by the Los Alamos Scientific Laboratory under conditions selected to obtain optimum precisions and accuracies. Data obtained under such conditions probably indicate the best results to be expected and, therefore, become very important in considerations of the capabilities of these methods for analysing nuclear fuels. Under optimum conditions the bias and relative standard deviation are in the range between 0.02 and 0.1%. Some of these methods are favoured because they apply to the measurement of uranium and plutonium without chemical separation. In general, for analyses of unirradiated fuels, and probably also for irradiated fuels, the controlled potential coulometric methods currently find more use because of their speed and the small sample size required; furthermore the measurements of each element are direct and independent. (auth)

76 SUMMARY OF EXPERIENCE OF SOME PLUTONIUM AND URANIUM METHODS AT WINDSCALE. Woodman, F. J. (United Kingdom Atomic Energy Authority, Windscale, Eng.). pp 81-84 of Analytical Chemistry of Nuclear Fuels. Vienna; International Atomic Energy Agency (1972).

From panel on the analytical chemistry of nuclear fuels; Vienna, Austria (13 Jul 1970). See STI/PUB-337; CONF-700732-.

The analytical methods used for the determination of uranium and plutonium at the Windscale plant of the U. K. A. E. A. are summarized. Values of the attainable precision are given together with comments on the selected methods. (auth)

77 APPLICATION OF PRECISE METHODS IN DETERMINING PLUTONIUM AND URANIUM IN UNIRRADIATED SINTERED MIXED OXIDE NUCLEAR FUEL. Metz, C. F.; Waterbury, G. R. (Los Alamos Scientific Lab., NM). pp 85-90 of Analytical Chemistry of Nuclear Fuels. Vienna; International Atomic Energy Agency (1972).

From panel on the analytical chemistry of nuclear fuels; Vienna, Austria (13 Jul 1970). See STI/PUB-337; CONF-700732-.

An evaluation was made of the adequacy of methods for determining uranium and plutonium in LMFBR-FFTF uranium–plutonium oxide fuel. This evaluation was based on statistical analyses of the results obtained by seven laboratories on a disturbed batch of FFTF fuel pellets and distributed special blends of certain impurities and a high purity uranium–plutonium matrix. (auth)

78 CHEMICAL ANALYSIS OF URANIUM AND PLUTONIUM OXIDES. Lorenzini, L. (CNEN–CSN, Casaccia, Italy). pp 91-96 of Analytical Chemistry of Nuclear Fuels. Vienna; International Atomic Energy Agency (1972).

From panel on the analytical chemistry of nuclear fuels; Vienna, Austria (13 Jul 1970). See STI/PUB-337; CONF-700732-.

The analytical procedures used at CNEN for the analysis of nuclear grade ceramic oxides are described. Stoichiometry is determined by one of three methods, viz. phosphoric acid dissolution followed by coulometric titration; CO/CO_2 equilibration combined with measurement of weight loss; and oxidation combined with measurement of weight gain. The applicability of each of these techniques is discussed. The determination of metallic and nonmetallic impurities in ceramic fuels is briefly discussed as well as isotopic analysis using surface ionization mass spectrometry. (auth)

79 APPLICATION OF ISOTOPE DILUTION MASS SPECTROMETRY TO THE DETERMINATION OF URANIUM AND PLUTONIUM IN NUCLEAR FUELS. Rein, J. E.; Metz, C. F. (Los Alamos Scientific Lab., NM). pp 97-109 of Analytical Chemistry of Nuclear Fuels. Vienna; International Atomic Energy Agency (1972).

From panel on the analytical chemistry of nuclear fuels; Vienna, Austria (13 Jul 1970). See STI/PUB-337; CONF-700732-.

The isotope dilution mass spectrometric technique is a universally applicable technique for the determination of uranium and plutonium. Its advantages for the analysis of nuclear fuels are (1) essentially complete independence of diverse ion effects, (2) use of non-quantitative chemical separations prior to the final measurement which, therefore, can be customized to provide very high separation factors for other transuranics and for fission products, (3) need of only submilligram amounts of uranium and submicrogram amounts of plutonium for analysis, and (4) simultaneous measurements of the isotopic distributions along with the determination of the total amounts of uranium and plutonium. The individual factors that control the accuracy and the precision of the technique are discussed especially with respect to the analysis of both non-irradiated and irradiated fuels. These factors are the dissolution of samples and preparation of aliquots for

analysis, the preparation and use of highly accurate isotope diluents, the separation chemistry for isolation of uranium and plutonium for the mass spectrometry measurement, and the mass spectrometry measurement itself. (auth)

80 POST-IRRADIATION ISOTOPIC ANALYSIS OF REACTOR FUELS. Koch, L. (EURATOM, Karlsruhe, Ger.). pp 111-118 of Analytical Chemistry of Nuclear Fuels. Vienna; International Atomic Energy Agency (1972).

From panel on the analytical chemistry of nuclear fuels; Vienna, Austria (13 Jul 1970). See STI/PUB-337; CONF-700732-.

The methods used for the determination of the isotopic composition of reactor fuels and fuel inventory at the Transuranium Institute are reviewed. Isotopic compositions are measured by means of mass spectrometry. Mass spectrometric techniques, combined with isotope dilution, are used for determining absolute quantities. For the determination of U/Pu ratios or for burnup determinations, double or triple "spikes" are used. The simultaneous determination of uranium and plutonium isotopes is considered. Prior to assay, the dissolved fuel is usually depleted with respect to uranium by means of a single separation of the plutonium as its Pu(IV) nitrato-complex on an anion exchange resin. A precision of 0.3% is obtained regardless of the initial U/Pu ratio of the specimens. Burnup determinations are made using fission product ^{148}Nd as burnup monitor. ^{148}Nd is separated by selective elution from an ion-exchange resin with alpha-hydroxy-iso-butyric acid and determined by mass spectrometry and isotope dilution analysis. The elution process is monitored by following the ^{241}Am activity which is eluted prior to the ^{148}Nd. (auth)

81 ADVANTAGES AND LIMITATIONS OF MASS SPECTROMETRY FOR THE MEASUREMENT OF THE ISOTOPIC DISTRIBUTIONS OF URANIUM AND PLUTONIUM AND APPLICATION TO NUCLEAR FUEL BURNUP. Rein, J. E.; Metz, C. F. (Los Alamos Scientific Lab., NM). pp 135-142 of Analytical Chemistry of Nuclear Fuels. Vienna; International Atomic Energy Agency (1972).

From panel on the analytical chemistry of nuclear fuels; Vienna, Austria (13 Jul 1970). See STI/PUB-337; CONF-700732-.

The surface ionization mass spectrometer is used almost exclusively for the measurement of uranium and plutonium isotopic distributions for the purpose of nuclear fuel burnup determination. The factors controlling the accuracy and precision of the isotope measurement are discussed from the standpoint of desirable instrumental features and desirable operational practices on the part of the mass spectrometrist. Typical precision and accuracy data obtained for uranium and plutonium isotopic distributions are presented with emphasis on data obtained on well characterized sample materials distributed to different laboratories. A critical discussion of the equations used to calculate burnup of uranium and plutonium that are based on measured changes in uranium and plutonium isotopic ratios of the pre-irradiated and post-irradiated fuel samples is presented. (auth)

82 DETERMINATION OF NUCLEAR FUEL BURNUP BASED ON ISOTOPE DILUTION MASS SPECTROMETRIC MEASUREMENTS. Rein, J. E.; Metz, C. F. (Los Alamos Scientific Lab., NM). pp 143-155 of Analytical Chemistry of Nuclear Fuels. Vienna; International Atomic Energy Agency (1972).

From panel on the analytical chemistry of nuclear fuels; Vienna, Austria (13 Jul 1970). See STI/PUB-337; CONF-700732-.

The technique of burnup measurements by isotope dilution mass spectrometric analysis of actinide and fission product isotopes generally is considered to give the most reliable results. The determination of burnup based solely on measurements for the amounts of actinide isotopes before and after irradiation is shown to be limited in application. Fission product isotopes are recommended for the measurements of total fissions and fractional fissions (from the individual fissioning actinide isotopes) in various types of nuclear fuels both for thermal reactors and fast reactors. The expected reliabilities of these measurements are discussed including a consideration of the sources of error in the measurements. Methods are critically reviewed for the chemical separation of recommended fission product burnup monitors for the isotope dilution mass spectrometric analysis that are applicable both to uranium and plutonium fuels. The future and complex needs of burnup analysis for fast breeder reactor fuels indicates that present techniques are not adequate. The marriage of the isotope dilution principle and spark source mass spectrometry for the simultaneous measurement of many actinide isotopes and fission products promises to become the technique of the future. (auth)

83 PRESENT STATUS OF VARIOUS ANALYTICAL METHODS IN USE AT CEA. Platzer, R. (CEN, Fontenay-Aux-Roses, France). pp 163-167 of Analytical Chemistry of Nuclear Fuels. Vienna; International Atomic Energy Agency (1972).

From panel on the analytical chemistry of nuclear fuels; Vienna, Austria (13 Jul 1970). See STI/PUB-337; CONF-700732-.

A review of the various methods of chemical analysis used at CEA is presented. Analyses performed are discussed with regard to fuel cycle plant operation, burnup measurements, specifications comparison, and other less routine activities. Reasons underlying the selection of methods used are discussed and the methods themselves are described. The general survey presented concludes that methods in use at CEA provide an effective accuracy generally between 0.1% and a few per cent. (auth)

Radiometric and Radiochemical Procedures

Refer also to abstracts 361, 397, 421, 424, 458, 497, and 754.

84 (AAEC/E-244) EFFECT OF VARIATIONS OF ENTRAINED AIR IN MINERAL SLURRIES ON THE PRECISION OF ON-STREAM ANALYSIS USING RADIOISOTOPE X-RAY TECHNIQUES. Watt, J. S. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Nov 1972. 13p. Dep. NTIS (U. S. Sales Only) $3.00.

Variations in entrained air in mineral slurries cause errors in on-stream x-ray analysis for element concentration in the slurry solids. Complete elimination of entrained air may not always be practicable, particularly for radioisotope x-ray techniques where probes are immersed directly into existing plant slurry vessels through which the whole process stream flows. Calculations of the effect of entrained air on precision of analysis show that x-ray preferential absorption techniques are usually much more affected than x-ray fluorescence techniques. Calculations agree reasonably well with results of plant trials of on-stream analysis. Errors in analysis using radioisotope immersion probes should in most cases be within limits acceptable for plant control. (auth)

85 (CEA-CONF-2180) MICROANALYSIS OF FISSION PRODUCTS IN IRRADIATED URANIUM OXIDE FUELS. Bazin, J.; Perrot, M.; Vignesoult, N.; Conty, C.; Guernet, J. (Continental Oil Co., Ponca City, Okla.). [nd]. 16p. (CONF-720714-2). Dep. NTIS (U. S. Sales Only) $3.00.

From 7th national conference on electron probe analysis; San Francisco, California, USA (17 Jul 1972).

The shielded electron microprobe is described and the techniques used for sample preparation are discussed. Results obtained on post-examination of irradiated zircaloy-clad UO_2 are presented that include distribution of Zr in the matrix, determination of precipitated fission products, and reactions between the fuel and zircaloy cladding. (DHM)

86 (CEA-CONF-2182) MEASUREMENT OF THE RATIO Pu/U BY X AUTOFLUORESCENCE IN IRRADIATED FUEL. Mouchnino, M. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). [nd]. 17p. (In French). (Conf-720649-4). Dep. NTIS (U. S. Sales Only) $3.00.

From fourteenth committee of hot laboratories of EURATOM; Petten, Netherlands (8 Jun 1972).

A new method of x-ray spectrophotometric analysis was used to measure the ratio Pu/(U + Pu) in irradiated samples. The precision is limited to 5%. It does not attain that obtained by chemical analysis. On the contrary, the fineness of the zone analyzed is that of a surface of 0.1 x 0.1 mm^2. The method does not make it possible to show the microheterogeneities such as are found in the oxides (gray phase (U,Pu)MC_3, MC = Ru, Rh, Pd). The method, derived from radial gamma spectrometry, makes it possible to demonstrate easily the phenomena of thermodiffusion of uranium and of plutonium that concern zones of the order of a millimeter as the examples given show. Some measurements made with a Si–Li diode for the purpose of extrapolating the method to low energies (5 to 30 keV) have not given satisfactory results. In such a case, it is hoped that it would be possible to obtain curves for the separation of the principal fission products (Mo, Ru, Ba) included in the oxide after irradiation. In order to obtain this result it is necessary to induce the fluorescence of the fission products by an auxiliary gamma and x-ray source of ^{137}Cs, for example. It is anticipated that in the near future such a method can be adopted for spectrometric measurements in a hot cell. (tr-auth)

87 (LA-UR-73-226) ROLE OF NUCLEAR DATA IN THE PRACTICAL APPLICATION OF NONDESTRUCTIVE NUCLEAR ASSAY METHODS. Thorpe, M. M. (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract W-7405-eng-36. 21p. (CONF-730302-9; SM-170/54). Dep. NTIS $3.25.

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973).

The role of nuclear data in the practical application of nondestructive nuclear assay methods is considered with respect to fuel pin assay; neutron methods applied to scrap and small sample assay; gamma methods; coincidence counting of fission events; and basic signatures. (DHM)

88 DEVELOPMENT OF A SYSTEM FOR TRACE ELEMENT ANALYSIS IN THE ENVIRONMENT BY CHARGED X-RAY FLUORESCENCE. Gordon, B. M.; Kraner, H. W. (Brookhaven National Lab., Upton, NY). J. Radional. Chem.; 12: No.1, 181-188(Oct 1972).

International meeting on chemical analysis by charged particle bombardment; Namur, Belgium (6 Sep 1971).

The development of charged particle x-ray fluorescence analysis for the determination of trace elements in biological, environmental, consumer product, and lunar samples is reported using protons, ^{4}He, and ^{16}O ions. (DHM)

89 CHEMICAL ANALYSIS OF HEAVY ELEMENTS BY IDENTIFICATION OF FISSION FRAGMENTS THROUGH X-RAY COINCIDENCE MEASUREMENTS. Moore, C. F.; Phillips, G. W.; St.-Laurent, R.; Hopkins, F.; White, J.; Richard, P. (Univ. of Texas, Austin). J. Radioanal. Chem.; 12: No. 1, 261-270(Oct 1972).

International meeting on chemical analysis by charged particle bombardment; Namur, Belgium (6 Sep 1971).

A two-parameter coincident (x-ray, x-ray) measurement was made using a Si(Li) x-ray detector and a Ge(Li) x-ray detector to study the x-ray production in the ^{252}Cf fission process. K x-ray peaks from adjacent Z fission products for elements Y through Rh and I through Pr are well resolved in both detectors. The measurement yields the result that there is a large number of coincident events with x-rays from the same Z element as well as with x-rays from the complementary fission product (e.g., Cs K X-rays are in coincidence with both the complementary Tc K x-rays and the Cs K x-rays). The various possibilities one may consider are: (1) K x-ray production by the primary fission process followed by internal conversion, (2) multiple K x-ray production in the stopping process of the fission products, (3) K shell ionization resulting from β-decay of the fission fragments followed by internal conversion in the same fragment, and (4) multiple internal conversion processes from cascading transitions. Each of these four possible causes for self-coincident x-ray production is explored. Further two-parameter measurements were made of low-energy γ-rays in coincidence with characteristic K x-rays from the individual elements formed in the fission. Combined with previous mass determinations, it was possible to identify many of the observed γ-rays with individual isotopes. However, a large number of low-energy transitions were observed and identified as to elemental charge, but which had not been seen previously so that no mass determination was possible. (auth)

90 PROTON MICROBEAMS, THEIR PRODUCTION AND USE. Cookson, J. A.; Ferguson, A. T. G.; Pilling, F. D. (Atomic Energy Research Establishment, Harwell, Eng.). J. Radioanal. Chem.; 12: No. 1, 39-52(Oct 1972).

International meeting on chemical analysis by charged particle bombardment; Namur, Belgium (6 Sep 1971).

Well focused beams of protons and other ions provide a very powerful means of determining how the elemental composition of a sample varies over its surface. Observation of the x-rays from proton bombardment can provide great sensitivity in most cases, while detection of nuclear effects has special applicability for elements of low atomic weight. A focusing system using high precision magnetic quadrupoles was designed and built for use with the IBIS 3 MeV Van de Graaff generator. Measurements of the first order focusing and aberrations agreed satisfactorily with theoretical predictions. The focused beam of 3 MeV protons was measured to have a diameter of less than 4 μm. The target chamber, deflection system and display system are described and examples given of use of the system. Backgrounds in x-ray detection are discussed and limits of detection are given. (auth)

91 RADIOMETRIC PROBLEMS IN TRITIUM AND ^{14}C DETERMINATION IN HYGIENIC PRACTICE. Kollar, J.; Chorvat, D.; Tatara, M. Prac. Lek.; 22: No. 1, 18-24(1970). (In Czech.).

Natural and artificial sources of the nuclides and their hygienic effect are discussed. Special attention is paid to the processing of samples, mechanism of detection, and quenching of samples. Criteria concerning the selection of the optimum scintillation system, methods of processing samples of water, inorganic salts and biological materials as well as dosimetric problems in processing samples containing tritium and ^{14}C were discussed. Some examples of the use of liquid scintillators, which seem to have good prospects in the radiation hygiene practice, are given. (auth)

92 TRACE ELEMENT ANALYSIS BY PROTON-INDUCED X-RAY EXCITATION. Young, F. C.; Roush, M. L.; Berman, P. G. (Univ. of Maryland, College Park). Int. J. Appl. Radiat. Isotop.; 24: No. 3, 153-163(Mar 1973).

The potential for simultaneous analysis of samples for traces of all elements with $Z \gtrsim 15$ by x-ray fluorescence using 2.5-MeV protons is described. Some advantages and limitations of this technique are presented. For samples of 10^{-4} g/cm^2 in thickness, sensitivities as small as 0.1 ppM can be expected. Measurements are presented on a variety of environmental and biological samples, including air pollution, sediment, plankton, perch blood and liver, enzyme, and hemoglobin samples. (auth)

93 SIMULTANEOUS DETERMINATION OF Zr AND Hf IN SOLUTION USING X-RAY FLUORESCENCE. Schriver, A. (Univ., Paris). Rev. Chim. Miner.; 9: No. 6, 917-924(1972). (In French).

X-ray fluorescence techniques were used to obtain accurate determinations of Zr and Hf down to 100×10^{-6} and 250×10^{-6} respectively. No interactions due to foreign elements (Ti, Cu) were observed. (France)

94 DETERMINATION OF ZINC IN CADMIUM PREPARATIONS BY A RADIOMETRIC METHOD. I. The Method of Calibration Curves Using Ion Exchange. Shamaev, V. I.; Martynov, A. M. Sov. Radiochem. (Engl. Transl.); 14: No. 3, 511-513(1972).

Translated from Radiokhimiya; 14: No. 3, 498-500(1972).

A simple and rapid radiometric method of determination of zinc in cadmium preparations without separation of these elements was developed. The possibility of using ion exchange resins as a reagent for the analysis of two component systems by the method of calibration curves was demonstrated. (auth)

95 DETERMINATION OF ZINC IN CADMIUM PREPARATIONS BY A RADIOMETRIC METHOD. II. The Method of Calibration Curves Using Extraction With Dithizone. Shamaev, V. I.; Martynov, A. M. Sov. Radiochem. (Engl. Transl.); 14: No. 3, 514-516(1972).

Translated from Radiokhimiya; 14: No. 3, 500-501(1972).

The substoichiometric extraction of zinc and cadmium with a solution of dithizone in chloroform was studied. A rapid, simple, and sufficiently accurate method of determining small quantities of zinc (from 1 to 25%) in cadmium was developed—a radiometric method of calibration curves, using dithizone as the reagent. (auth)

96 COMPARATIVE STUDY OF ALPHA AND X-RAY INDUCED X-RAY EMISSION FOR ELEMENTAL ANALYSIS. Perry, S. K.; Brady, F. P. (Univ. of California, Davis). Nucl. Instrum. Methods; 108: No. 2, 389-396(1973).

A variety of specimens have been prepared as thin homogeneous targets and analyzed by alpha induced x-ray emission and x-ray fluorescence. The sensitivities for these two modes of excitation were compared and a figure of merit obtained. (auth)

97 DETERMINATION OF ACTINIDE ELEMENTS BY X-RAY ANALYSIS. von Baeckmann, A. (Kernforschungszentrum, Karlsruhe, Ger.). pp 33-44 of Analytical Chemistry of Nuclear Fuels. Vienna; International Atomic Energy Agency (1972).

From panel on the analytical chemistry of nuclear fuels; Vienna, Austria (13 Jul 1970). See STI/PUB-337; CONF-700732-.

The accurate determination of uranium and plutonium in solution by means of x-ray fluorescence analysis is described. The application of the fluorescence method to the determination of uranium and plutonium concentrations in dissolved irradiated and non-irradiated nuclear fuels is discussed. Relative standard deviations of less than 1% are readily obtainable and the results obtained by the fluorescence method agree well with the results obtained by mass spectroscopic-isotope dilution analysis with a systematic deviation between the two methods of about 0.3%. The requirements of a suitable x-ray spectrometer are briefly reviewed as well as the precautions required in the handling and storage of samples. Uranium and plutonium concentrations can readily be determined with a relative error of 1% in dissolver solutions. (auth)

98 CURRENT WORK ON THE DEVELOPMENT OF RADIOCHEMICAL METHODS FOR THE DETERMINATION OF NUCLEAR FUEL BURNUP IN POLAND. Smulek, W.; Zelenay, T. (Inst. of Nuclear Research, Warsaw). pp 119-129 of Analytical Chemistry of Nuclear Fuels. Vienna; International Atomic Energy Agency (1972).

From panel on the analytical chemistry of nuclear fuels; Vienna, Austria (13 Jul 1970). See STI/PUB-337; CONF-700732-.

The radiochemical methods which have been developed for the measurement of the burnup of nuclear fuels are reviewed. Studies on fission products are described which use either inactive or short-time irradiated UO_2–Mg fuel. The separation techniques

described include mainly extraction chromatography and solvent extraction. Methods for separating cesium, cerium, neodymium, europium, ruthenium, and barium–lanthanum from irradiated fuels are given. The results obtained from the use of different fission products as burnup monitors are compared. (auth)

99 DETERMINATION OF THE BURNUP OF NUCLEAR FUEL BY RADIOCHEMICAL METHODS. Krivanek, M.; Krtil, J. (Inst. of Nuclear Research, Prague). pp 131-133 of Analytical Chemistry of Nuclear Fuels. Vienna; International Atomic Energy Agency (1972).

From panel on the analytical chemistry of nuclear fuels; Vienna, Austria (13 Jul 1970). See STI/PUB-337; CONF-700732-.

Radiochemical methods for the determination of burnup, which are based on the use of the fission product burnup monitors ^{95}Zr, ^{137}Cs and ^{144}Ce, are described. The separation techniques used are outlined, and the results of burnup measurements of various fuels by radiochemical methods presented. Some results showing the agreement between burnup measurements based on the fission product monitors ^{144}Ce and ^{137}Cs (radiochemical) and ^{148}Nd (mass-spectrometry and isotope dilution) are given. (auth)

100 ANALYTICAL METHODS FOR NUCLEAR FUELS USED AT STUDSVIK. Blomquist, G. (Aktiebolaget Atomenergi, Studsvik, Sweden). pp 157-161 of Analytical Chemistry of Nuclear Fuels. Vienna; International Atomic Energy Agency (1972).

From panel on the analytical chemistry of nuclear fuels; Vienna, Austria (13 Jul 1970). See STI/PUB-337; CONF-700732-.

The methods in use at Studsvik for the analysis of nuclear fuels are summarized. Burnup is measured by a mass spectrometric method using molybdenum as fission product monitor. ^{140}La, assayed by radiochemical methods, is also used for burnup measurements on low burnup fuels. The problem of impurity determinations in plutonium dioxide-based fuels is briefly discussed and the calculation of oxygen to metal ratios in mixed oxides is also considered. (auth)

101 HIGH-RESOLUTION ELECTRON-MICROAUTORADIOGRAPHY APPLIED TO METALLURGY. Laurent, J. P.; Lapasset, G. (Paris Univ., Orsay, France). Int. J. Appl. Radiat. Isotop.; 24: No. 4, 213-230(Apr 1973). (In French).

High-resolution autoradiography is able to localize radioactive traces in metals with reference to the structural defects. The sensitivity of available emulsions is sufficient to detect very low concentrations (less than 0.01 ppM) in reasonable exposure times (1 day to 1 month), especially as the radiotracer is segregated on structure defects. The resolution limit is about 3000 Å for strongly ionizing emitters, such as tritium (18 keV). It becomes 4 to 10 μm when the radioisotope emits stronger electrons (^{14}C: 155 keV) depending on the nature and the position in the metal of the source. Precautions must be taken if concentrations are to be measured by this method. Quantitative results are still uncertain but they give information that can not be obtained by any other technique. Difficulties in the interpretation of autoradiographs and artefacts detection can be generally removed by control experiments on non-active specimens submitted to the same procedure as radioactive specimens. (auth)

Separation Procedures

Refer also to abstracts 277 and 410.

102 SORPTION OF METAL CATIONS BY A SELECTIVE CATION EXCHANGER (OXIDISED CHARCOAL). Tomashevskaya, A. N.; Tarkovskaya, I. A.; Goba, V. E.; Strazhesko, D. N. (Inst. of Physical Chemistry, Kiev). Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 8, 1213-1214(Aug 1972).

Translated from Zh. Fiz. Khim.; 46: No. 8, 2126-2127(Aug 1972).

The constants for ion exchange on oxidized charcoal in various systems were determined in order to characterize quantitatively its high selectivity and the instability constants of the surface complexes formed by the sorbed ions with the functional groups on the charcoal have been calculated. Instability constants are tabulated for complexes of Na, Ca, Sr, Zn, Co, Ni, Sc, La, and Fe. (auth)

103 MOLECULAR SORPTION ACCOMPANYING ION EXCHANGE ON ANION EXCHANGERS. II. Exchanges Involving Rare Earth Metal Ethylenediaminetetra-Acetate Complexes With Chloride and Acetate Ions on AN-2F, AV-21, and AN-261 Anion-Exchange Resins. Legenchenko, I. A.; Khromova, N. P. (Inst. of General and Inorganic Chemistry, Odessa). Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 8, 1189-1191(Aug 1972).

Translated from Zh. Fiz. Khim.; 46: No. 8, 2082-2085(Aug 1972).

A description is given of aspects of sorption accompanying the exchange of ethylenediaminetetra-acetate complexes of rare earth metals with chloride and acetate anions on AN-2F and in the exchange of $LnEdta^-$ for chloride on AV-21 and AN-261 anion exchange resins. These peculiarities are explained satisfactorily by association in the exchanger phase. (auth)

104 MOLECULAR SORPTION ACCOMPANYING ION EXCHANGE ON ANION EXCHANGERS. I. Exchanges Involving Rare-Earth Ethylenediaminetetra-Acetate Complexes With Chloride and Acetate Ions on AV-17 Anion-Exchange Resin. Legenchenko, I. A.; Khromova, N. P. (Inst. of General and Inorganic Chemistry, Odessa). Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 8, 1186-1188(Aug 1972).

Translated from Zh. Fiz. Khim.; 46: No. 8, 2078-2081(Aug 1972).

Aspects of sorption accompanying the exchange of complexes of the type $LnEdta^-$ with chloride and acetate ions, and of H_2Edta^{2-} with chloride ions, on the highly basic anion exchanger AV-17 are described. An explanation of the observed phenomena is attempted in terms of the theory of association. (auth)

105 TLC SEPARATIONS OF U, V, Mo; Ti, Zr; Co, Ni; Cu, Fe. Rajeev, R. C. G.; Srivastava, S. P. (Univ. of Roorkee, India). Z. Anal. Chem.; 262: No. 5, 364-365(1972).

Various solvents were examined as developers and it was found that the separations could be achieved with n-butanol : HCl : water and n-butanol : formic acid : water mixtures with varying compositions of the acids. The spots were visualized by spraying with the freshly prepared ferrocyanide spraying reagent. Data show that U, V, and Mo can be satisfactorily separated both in n-BuOH/HCl/H_2O mixture (80 : 30 : 60) and in n-BuOH/HCOOH/H_2O (80 : 30 : 60), Cu and Fe only in the former one. On the other hand Ti and Zr; Co and Ni can be successfully separated in n-BuOH/HCl/H_2O mixture (80 : 50 : 60) only. (DHM)

106 EXTRACTION OF URANIUM(IV) FROM AQUEOUS NITRIC ACID SOLUTIONS BY THE TERTIARY AMMONIUM SALT TRILAURYLAMMONIUM NITRATE. Schmid, E. R.; Juenger, E. (Univ., Vienna). J. Inorg. Nucl. Chem.; 35: No. 5, 1671-1683(May 1973). (In German).

The extraction of uranium(IV) from nitric acid solutions by the nitrate salt of the tertiary amine trilaurylamine in various solvents is described. Effects of the following parameters on the uranium(IV) extraction were investigated: equilibrium concentration of the nitric acid in the aqueous phase, nitrate molarity at constant ionic strength, salting-out agents, octanol concentration of the organic phase, solvent, acid content of the organic phase, amine concentration, and uranium(IV) concentration. The experimental results indicate that the uranium(IV) extraction is determined by the competition between the uranium complex and nitric acid as solvating partners for the extracting agent in the organic solution. By determining the slope of a log–log plot of the distribution coefficient and the concentration of the extractant, by maximum loading experiments and by investigating the uranium spectra of the organic phase, the metal species in the organic phase could be identified as the bis-(trialkylammonium)-hexanitratouranium(IV) complex $[(R_3NH)_2 U(NO_3)_6]$. (auth)

107 EXTRACTION OF HAFNIUM WITH THE AID OF DIANTIPYRYLPROPYLMETHANE. Naier, R. G.; Rudenko, N. P. Sov. Radiochem. (Engl. Transl.); 14: No. 3, 487-488(1972).

Translated from Radiokhimiya; 14: No. 3, 480-482(1972).

The extraction of hafnium (^{181}Hf with a carrier in a concentration of ~10^{-6} g-atom/liter) with chloroform solutions of diantipyrylpropylmethane (DP) of four concentrations was studied. On the basis of spectrophotometric measurements of a series of isomolar solutions of hafnium and DP and the dependence of the distribution coefficient on $[H_2DP^{2+}]$, it was suggested that hafnium, just like zirconium, is extracted in the form of an ionic associate, the cationic portion of which is the doubly charged diantipyrylmethanium (H_2DP^{2+}) ion. From the calculated values of the extraction constants (99 for Zr, 8 for Hf) and distribution coefficients (E_{max} = 16.6 and 1.6 for zirconium and hafnium, respectively), it was hypothesized that DP can be used in a multistage extraction or chromatographic process for the separation of zirconium and hafnium. (auth)

108 EXTRACTION OF ZIRCONIUM-95 AND HAFNIUM IN THE FORM OF COMPLEX COMPOUNDS WITH 1-NITROSO-2-NAPHTHOL. Rudenko, N. P.; Naier, R. G. Sov. Radiochem. (Engl. Transl.); 14: No. 3, 484-486(1972).

Translated from Radiokhimiya; 14: No. 3, 478-480(1972).

The extraction of zirconium and hafnium by chloroform solutions of 1-nitroso-2-naphthol (HA) of five concentrations was studied as a function of the activity of the aqueous phase. It was established that zirconium and hafnium are extracted in the form of complex compounds, containing two anions of the reagent. The extraction constants, calculated from the expression $K_{ext} = D[HA]^2 \cdot [HCl]^2$ (D is the distribution coefficient of the element between the organic and aqueous phases), are equal to 891 for zirconium and

110 for hafnium. The values of the stepwise and general stability constants of zirconium and hafnium 1-nitroso-2-naphtholates were calculated by the Leden–Rydberg, Bjerrum, and Dyrsson–Sillen methods. (auth)

109 QUANTITATIVE CHARACTERISTICS OF THE EXTRACTION OF NITRIC ACID BY DI-2-ETHYLHEXYLPHOSPHORIC ACID. Rozen, A. M.; Martynov, B. V.; Anikin, V. I. Sov. Radiochem. (Engl. Transl.); 14: No. 3, 482-483(1972).

Translated from Radiokhimiya; 14: No. 3, 476-477(1972).

*The extraction of nitric acid by a 0.195 M solution of D2EHPA in CCl_4 was measured. The extraction constant, calculated on the as-*sumption of the formation of hydrated monosolvate of nitric acid with dimer D2EHPA, proved equal to 3.4×10^{-3}. The same order of the constant was found in a treatment of the literature data on the extraction of nitric acid by D2EHPA in other diluents. In the extraction of undiluted D2EHPA, the value of the constant increases to 2.1×10^{-2}, which is explained by an increase in the activity of D2EHPA. (auth)

110 EXTRACTION OF URANIUM, ZIRCONIUM, AND RUTHENIUM(III) NITROSONITRATES FROM NITRIC ACID SOLUTIONS BY AMINES OF VARIOUS STRUCTURES. Mezhov, E. A.; Novikova, S. S.; Shmidt, V. T. Sov. Radiochem. (Engl. Transl.); 14: No. 3, 478-481(1972).

Translated from Radiokhimiya; 14: No. 3, 473-476(1972).

The effects of the number of alkyl chains in the amine, the effects of the length of the alkyl chains in trialkyl amines, the effects of the length of the alkyl chain between the C_6H_5 radical and the nitrogen atom in aromatic–aliphatic amines, the effects of substituents in the aromatic rings of aryldialkylamines, and the effects of certain substituents at the nitrogen atom on the extraction of uranium(VI) by amines are considered. No definite correlation could be made between the ability of amines to extract zirconium and ruthenium and the structure of the amines. (DHM)

111 METHOD OF ELECTROFOCUSING OF IONS. Separation of ^{59}Fe–^{90}Y–^{90}Sr–^{134}Cs. Shvedov, V. P.; Semanov, G. N.; Ivanov, V. N. Sov. Radiochem. (Engl. Transl.); 14: No. 3, 472-475 (1972).

Translated from Radiokhimiya; 14: No. 3, 466-470(1972).

The possibility of separation of ^{59}Fe, ^{90}Y, ^{90}Sr, and ^{134}Cs, taken without carriers, by the method of electrofocusing of ions was studied with variation of its parameters. It was established that the optimum conditions for the separation of a mixture of ^{59}Fe–^{90}Y–^{90}Sr–^{134}Cs are: time of separation 6 min, electric field intensity 25 V/cm, catholyte 0.25 M $C_6H_8O_7$ + 0.02 M EDTA, anolyte 0.5 M HCl. The distance between zones in this case Fe/Y = 9 mm, Y/Sr = 15 mm. The possibility of the separation of small quantities of Y, Sr, and Cs from large quantities of Fe at the ratio Fe: (Y + Sr + Cs) = 100 : 1, at a concentration of Fe of 1 mg/ml was established. (auth)

112 RATE OF EXTRACTION IN SYSTEMS WITH TRIBUTYL PHOSPHATE. V. Kinetics of the Mass Transport of Uranium and Plutonium During Mixing in a Centrifugal Field. Shchepetil'nikov, N. N.; Kuznetsov, G. I.; Pushlenkov, M. F.; Yakovlev, G. N. Sov. Radiochem. (Engl. Transl.); 14: No. 3, 356-363(1972).

Translated from Radiokhimiya; 14: No. 3, 344-352(1972).

In a study of the kinetics of the mass transport of uranyl and plutonium(IV) nitrates from an aqueous nitric acid solution to tributyl phosphate, diluted with a mixture of saturated hydrocarbons or with carbon tetrachloride, a strong dependence of the rate of extraction of these components in a centrifugal apparatus on the rate of mixing was demonstrated using a centrifugal apparatus. The data obtained were compared with the results obtained in a laboratory gravitational extractor with a fixed interfacial surface. The dependence of the rate of extraction of uranium on its concentration, the tributyl phosphate concentration, and on the fraction of the dispersed phase was discussed. It was concluded that the extraction process is limited by convective diffusion under the conditions considered. Maxima on the kinetic curves were detected in a number of cases under conditions of intensive prolonged mixing. In the case of joint extraction the rate of passage of plutonium into the organic phase was higher than the rate of transfer of uranium. As the extraction reagent becomes saturated with uranium, there is a decrease in the plutonium concentration in the organic phase. (auth)

113 CHROMATOGRAPHIC SEPARATION OF RADIOACTIVE NOBLE GASES ON CARBON SORBENTS. II. Investigation of the Mechanism of the Blurring of the Chromatographic Peaks of ^{85}Kr and ^{133}Xe. Trofimov, A. M.; Pankov, A. M. Sov. Radiochem. (Engl. Transl.); 14: No. 3, 438-442(1972).

Translated from Radiokhimiya; 14: No. 3, 431-436(1972).

The basic causes of the blurring of the chromatographic peaks of ^{85}Kr and ^{133}Xe are the slowness of the kinetics of sorption and convective longitudinal diffusion. The type of sorbent and its grain size determine the predominant mechanism of blurring. Increasing the temperature of the experiment leads to an increase in the rate of the kinetics of sorption, and the broadening of the peaks of ^{85}Kr and ^{133}Xe begins to be determined by convective longitudinal diffusion. In the transition from a helium eluent to air and carbon dioxide, the rate of the kinetics of sorption is reduced, and it becomes the basic cause of the blurring of the peaks of radioactive noble gases. (auth)

114 CHROMATOGRAPHIC SEPARATION OF RADIOACTIVE NOBLE GASES ON CARBON SORBENTS. I. Investigation of the Influence of the Experimental Parameters on the Chromatographic Process. Trofimov, A. M.; Pankov, A. M. Sov. Radiochem. (Engl. Transl.); 14: No. 3, 432-437(1972).

Translated from Radiokhimiya; 14: No. 3, 424-430(1972).

It was established that sorbents form the following series with respect to their separating power: SKT-M > AG-2 > AG-5 > AR-3 > BAU. Increasing the length of the layer leads to an increase in the criterion of separation specifically for each type of sorbent and type of eluent. The value of the criterion of separation of ^{85}Kr and ^{133}Xe decreases as the eluent changes from helium to air and carbon dioxide. An increase in the carrier gas velocity led to a broadening of the peaks of ^{85}Kr and ^{133}Xe. A decrease in the grain size of the sorbent and reduction of the temperature of the experiment increase the criterion of separation of ^{85}Kr and ^{133}Xe. (auth)

115 INVESTIGATION OF THE STATE OF MICROCONCENTRATIONS OF CERIUM(IV) BY A RADIOCHEMICAL METHOD. II. The State of $^{144}Ce(IV)$ in Aqueous Solutions at pH = 3 to 6. Skul'skii, A. I. Sov. Radiochem. (Engl. Transl.); 14: No. 3, 426-431(1972).

Translated from Radiokhimiya; 14: No. 3, 417-424(1972).

At pH above 3.5 to 4.0 more coarsely dispersed hydrolysis products of $^{144}Ce(IV)$, possessing lower adsorption capacity, are formed than at pH = 2 to 3. The degree of retention of $^{144}Pr(III)$ in the phase of $^{144}Ce(IV)$ is close or equal to 100%. The production of more highly dispersed solutions becomes impossible. This may explain the maximum of the adsorbability of microconcentrations of radioisotopes of tetravalent elements in the region of pH = 2 to 3, observed by many researchers. At pH about 6, the adsorbability of $^{144}Ce(III)$ and $^{144}Pr(III)$ from exposed solutions is higher than that from freshly prepared solutions. Moreover, the adsorbability of $^{144}Pr(III)$ remains equal to the adsorbability of $^{144}Ce(III)$. Since the increase in the adsorbability of the shortlived ^{144}Pr, observed for several hours and days, cannot be explained by age changes in the properties of its own hydrolysis products, it follows that a colloidal phase of the parent $^{144}Ce(III)$ is formed, in which the daughter ^{144}Pr is retained, and entirely repeats the adsorption behavior of cerium. (auth)

116 INVESTIGATION OF THE STATE OF MICROCONCENTRATIONS OF CERIUM(IV) BY A RADIOCHEMICAL METHOD. I. The State of $^{144}Ce(IV)$ in Aqueous Solutions at pH = 2 to 3. Skul'skii, I. A. Sov. Radiochem. (Engl. Transl.); 14: No. 3, 419-425(1972).

Translated from Radiokhimiya; 14: No. 3, 409-417(1972).

A comparative investigation of the adsorption of $^{144}Ce(IV)$ and $^{144}Pr(III)$ from aqueous solutions on Teflon showed that at pH = 2 to 3 and cerium concentrations of the order of 10^{-8} M, hydrolysis products of Ce(IV) are formed that are capable of retaining the daughter $^{144}Pr(III)$. The degree of retention of ^{144}Pr in the phase of ^{144}Ce varies from 15 to 20 to 100% and depends on such factors as the age of the solutions, the conditions of their preparation, the pH, etc. The change in the degree of dispersion or complexity of the structure of colloidal particles and hydroxo-complexes of Ce(IV) can be judged qualitatively according to the change in the degree of retention. The increase in the adsorbability of microconcentrations of $^{144}Ce(IV)$ by one to two orders of magnitude in comparison with $^{144}Ce(III)$, which most likely exists in the form of $CeOH^{2+}$ at pH = 2 to 3, should be considered as a reflection of the thermodynamic instability of the intermediate products of the hydrolysis of Ce(IV), which tend to associate or be deposited on a suitable surface. (auth)

117 EXTRACTION OF NITRIC ACID AND PLUTONIUM(IV) FROM NITRIC ACID SOLUTIONS WITH AMINES OF VARIOUS STRUCTURES. Mezhov, E. A.; Shmidt, V. S. Sov. Radiochem. (Engl. Transl.); 14: No. 3, 349-355(1972).

Translated from Radiokhimiya; 14: No. 3, 337-344(1972).

Data on the extraction capacity of 28 amines of different structures were discussed. For convenience of their comparison, the extraction constants of nitric acid and plutonium(IV) nitrate by these amines were calculated. It was shown that in the extraction of these compounds general principles relating the extraction capacity of amines to their structure, derived on the basis of a consideration of the influence of the inductive and steric effects of the substituents, are observed. (auth)

118 TEMPERATURE SYSTEM OF THE CALCINATION OF SAMPLES OF GLOBAL RADIOACTIVE FALLOUT. Gedeonov, L. I.; Zhilkina, M. I.; Blinov, V. A.; Gritchenko, Z. G.; Kuznetsov, M. I. Sov. Radiochem. (Engl. Transl.); 14: No. 3, 458-463(1972). Translated from Radiokhimiya; 14: No. 3, 451-457(1972).

The relative contribution of the β activity of individual volatile radionuclides of artificial origin to the β activity of the sum of fission products of uranium as a function of the time elapsed after fission was calculated. Calcination of samples of global radioactive fallout in the temperature interval 200 to 1000°C is accompanied by volatilization of β-active substances. The degree of volatilization of β-active substances. The degree of volatilization depends on the temperature system of calcination of the samples and the relative contribution of the activity of volatile radionuclides to the β activity of the sum of fission products; losses of ^{106}Ru and ^{137}Cs during calcination of samples in the investigated temperature interval, due to their volatilization, may reach 50 and 70%, respectively. Recommendations are given for the selection of the optimum temperature system of calcination of samples of various objects of the external environment (atmospheric precipitation, aerosols of air, atmospheric fallout, food products and plants, natural waters, etc.). (auth)

119 ELECTROCHEMICAL SEPARATION OF ELEMENTS USING LIQUID METALLIC ELECTRODES. Lebedev, V. A.; Kober, V. I.; Nichkov, I. F.; Raspopin, S. P. (Ural Polytechnic Inst., Sverdlovsk, USSR). Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 9, 1344-1346(Sep 1972). Translated from Zh. Fiz. Khim.; 46: No. 9, 2356-2359(Sep 1972).

A relation was derived whereby it is possible to estimate from a single experimentally determined quantity and the solubilities of the elements in liquid metals the degree of electrochemical separation of elements using liquid metallic electrodes. The possibility of separating Ce–La and Ce–Y was explored. (auth)

120 SEALED-TUBE DISSOLUTION METHOD WITH APPLICATIONS TO PLUTONIUM-CONTAINING MATERIALS. Metz, C. F.; Waterbury, G. R. (Los Alamos Scientific Lab., NM). pp 59-65 of Analytical Chemistry of Nuclear Fuels. Vienna; International Atomic Energy Agency (1972).

From panel on the analytical chemistry of nuclear fuels; Vienna, Austria (13 Jul 1970). See STI/PUB-337; CONF-700732-.

Experience with a previously known technique for dissolving highly refractory materials is described. This technique, which seems to have been overlooked by most laboratories, has been found to have wide application. It consists of sealing the sample together with hydrochloric acid and an oxidant in a heavy-walled silica tube and heating to a suitable temperature, usually between 100 and 350°C. The sealed silica tube is first placed in a steel shell to which solid carbon dioxide is added to compensate for the high internal pressure generated in the tube. Application of this dissolution method to refractory plutonium containing materials is described in detail. (auth)

121 SEPARATION OF LIGHT LANTHANONS BY ION EXCHANGE WITH NTA AS AN ELUENT AND NICKEL AS A RETAINING OR DISPLACING ION. Frank, B. Ann. Univ. Mariae Curie Sklodowska, Lublin-Pol., Sect. AA; 26-27: 255-261(1971). (In Polish).

The separation of light lanthanons mixture was made with nickel ion as the retaining or displacing ion. During the elution with 1.5% NH_4–NTA (nitrilotriacetate) solution of increasing pH values on columns filled with Zerolit 225X8 in the form of Ni^{+2} it was found that the effectiveness of separation depends on the rate of pH change in the eluent and on the per cent composition of particular lanthanons in the separated mixture. During the elution with 1% Ni–NTA solution and with columns in the form of NH_4^+ heavy lanthanons can be quite well separated (i.e., yttrium and samarium from neodymium), their concentration, however, is low in the fractions. The elution ended with 1.5% NH_4–NTA solution of pH 5.5, the pair Nd–Pr being well separated. (auth)

122 INFLUENCE OF PULSED AND REVERSING CURRENT ON PURIFICATION OF ZIRCONIUM AND HAFNIUM DURING ELECTROLYSIS OF CHLORIDE–FLUORIDE MELTS. Petenev, O. S.; Ivanovskii, L. E. Tr. Inst. Elektrokhim., Ural. Nauch. Tsentr Akad. Nauk; No. 17, 127-130(1971). (In Russian).

The influence of pulsed and reversing current on the separation of Zr and Hf during electrolysis of chloride–fluoride melts is studied. It is shown that the use of reversing or pulsed current allows the separation factor to be increased by 2 to 3 times in comparison with constant current. (auth) (JPRS)

123 SEPARATION OF YTTRIUM FROM LIGHT LANTHANONS BY ION EXCHANGE WITH NTA AS A ELUENT AND CADMIUM AS A RETAINING OR DISPLACING ION. Hubicki, W.; Frank, B. Ann. Univ. Mariae Curie-Sklodowska, Lublin-Pol., Sect. AA; 26-27: 235-240(1971). (In Polish).

The separation of yttrium from samarium and neodymium was made, using cadmium as a retaining ion. It was found that better results can be obtained when applying Cd–NTA solution and developing columns in the form of Cd^{2+}. (auth)

124 ATTEMPTS AT SEPARATING Nd–Y PAIR BY FRACTIONAL PRECIPITATION OF TEREPHTHALATES. Brzyska, W. Ann. Univ. Mariae Curie-Sklodowska, Lublin-Pol., Sect. AA; 26-27: 121-126(1971). (In Polish).

Attempts were made at separating Nd–Y pair by fractional precipitation of terephthalates in the presence of the complexing agent EDTA. The enrichment of fractions varied and depended on the quantity of the complexing agent and composition of the solution used. The first fractions were found to be enriched with neodymium, whereas the final fractions with yttrium. Several repetitions of that procedure permitted the isolation of relatively pure neodymium and yttrium. (auth)

125 SEPARATION OF LIGHT LANTHANONS BY ION EXCHANGE WITH NTA AS AN ELUENT AND COBALT AS A RETAINING OR DISPLACING ION. Frank, B. Ann. Univ. Mariae Curie Sklodowska, Lublin-Pol., Sect. AA; 26-27: 249-254(1971). (In Polish).

Light lanthanons were separated by means of 1.5% NH_4–NTA (nitrilotriacetate) solution of pH 2.6 to 4.8. The developing column was used in the form of Co^{2+}. The concentration of lanthanons was high in the fractions; however, a good separation was not obtained. The pairs Nd–Pr and Pr–La were well separated when 1.5% Co–NTA solution of pH 4.0 to 4.9 was used as an eluent and developing columns were in the form of NH_4^+. (auth)

126 SEPARATION OF LIGHT LANTHANONS BY ION EXCHANGE WITH NTA AS AN ELUENT AND ZINC AS A RETAINING OR DISPLACING ION. Hubicki, W.; Frank, B. Ann. Univ. Mariae Curie-Sklodowska, Lublin-Pol., Sect. AA; 26-27: 241-248(1971). (In Polish).

The ion exchange separation of the rare earth elements was made using NTA (nitrilotriacetic acid) and zinc as a retaining ion. It was found that good results of separation could be obtained using Zn–NTA solution; however, the concentration of lanthanons was very low in the fractions. The process of elution was then almost two times longer than during the separation with NH_4–NTA solution, using developing columns in the form of Zn^{2+} or NH_4^+. (auth)

127 SEPARATION OF HEAVY LANTHANONS BY ION EXCHANGE WITH NTA AS AN ELUENT AND CADMIUM AS A RETAINING OR DISPLACING ION. Hubicki, W.; Frank, B.; Wysocka Lisek, J. Ann. Univ. Mariae Curie-Sklodowska, Lublin Pol., Sect. AA; 26-27: 223-233(1971). (In Polish).

The separation of heavy lanthanons by means of NH_4–NTA (nitrilotriacetate) solutions of different pH and developing columns in the form of Cd^{2+} was investigated. It was found that cadmium had a marked influence on the separation of heavy lanthanons, especially when the elution was made with 1% NH_4–NTA solution of pH ≤ 3. In the case examined the behavior of yttrium varied. At pH < 3 yttrium was eluated with lutetium, ytterbium, thulium, and erbium, whereas at pH > 3 with samarium, gadolinium, and europium. (auth)

Inorganic, Organic, and Physical Chemistry

Refer also to abstracts 41, 224, 225, 250, 615, 788, and 1944.

Chemical and Physicochemical Properties

128 (CONF-730106–2) PREPARATION OF A MASTER LIST OF CHEMICALS USED IN COOLING TOWERS FOR USE IN PREPARATION OF ENVIRONMENTAL IMPACT STATEMENTS. Rainey, R. H. (Oak Ridge National Lab., Tenn.). 1972. 6p. Dep. NTIS.

From 1973 annual cooling tower institute meeting; Houston, Texas, USA (29 Jan 1973).

The system proposed for preparing a master list of chemicals used in cooling towers is discussed. The problems involving classified materials are also considered. (DHM)

129 PERFORMANCE OF VARIOUS IMPREGNATED ACTIVATED CHARCOAL CARTRIDGES AND FILTER PAPER FOR SAMPLING AIRBORNE RADIOIODINE. Naritomi, M.; Fukuda, S. (Japan Atomic Energy Research Inst., Tokai). Nippon Genshiryoku Gakkaishi; 14: No. 10, 531-539(Oct 1972). (In Japanese).

In order to improve the performance of a commercially available charcoal filter paper (Toyo Roshi, Type CP-20) and of a charcoal cartridge (Toyo Roshi, Type CHC-50) for collecting airborne radioiodine under high relative humidity, the charcoals were impregnated with triethylenediamine (TEDA), stannous iodide (SnI_2), potassium iodide ($KI + I_2$) or with potassium thiocyanate (KSCN).

The impregnated charcoals were examined for their dependence of collection efficiency on the properties of airborne iodine, on the sampling period and on the face velocity, and the results were compared with unimpregnated charcoal as reference. The airborne radioiodine used as samples was obtained from the exhaust ventilation systems at the ^{131}I production plant, and from the fuel reprocessing test plant, both belonging to the Japan Atomic Energy Research Institute. The charcoals impregnated with TEDA or SnI_2 were found to show greatly improved performance compared with the unimpregnated charcoals; the collection efficiency of the charcoal cartridge and of the charcoal filter paper was maintained at levels above 85 and 80%, respectively, over a period of 14 hr of sampling. It was found, however, that the collection performance was impaired by the presence of chemically reactive gases such as NO_2 and organic vapor. The charcoals impregnated with $(KI + I_2)$ and with KSCN showed almost no improvement in their collection efficiencies. (auth)

130 SOME APPLICATIONS OF INELASTIC NEUTRON SCATTERING SPECTROSCOPY TO SURFACE CHEMISTRY AND CATALYSIS. White, J. W. (St. John's Coll., Oxford). pp 315-344 of Neutron Inelastic Scattering, 1972. Vienna; International Atomic Energy Agency (1972).

From fifth IAEA symposium on neutron inelastic scattering; Grenoble, France (6 Mar 1972). See STI/PUB-308; CONF-720304-.

Recent developments in high-resolution incoherent inelastic neutron scattering spectroscopy (I.N.S.) as applied to molecular vibrations are reviewed with particular relevance to the present and potential use of this technique in studying the mechanisms of homogeneous and heterogeneous chemical catalysis. It is shown that the scattering cross-section and vibrational amplitude weighting factors in I.N.S. have unique value not only for characterizing reactive carbonyl hydride intermediates but also because hydrogen atom vibrations can be used as a sensitive probe of molecular symmetry. Applications to heterogeneous catalysis depend on the above and also on the use of the momentum transfer variable in neutron spectroscopy to test models of molecular rate processes resulting from the gas surface and liquid surface interactions in these systems. Recent developments in the understanding of quasielastic scattering from water and ionic solutions, including studies of the motion of strongly scattering probe ions, are reviewed. Finally, the range of the ordering forces resulting from the interaction of liquid water with well-characterized aluminosilicate surfaces is measured and shown to have a characteristic distance of about 15 Å for the recovery of bulk liquid diffusional behaviour. (auth)

Isotope Effects

Refer also to abstracts 240, 724, 744, and 883.

131 DEUTERIUM EFFECT ON THE TRIPLET RADIATIVE DECAY RATE OF AROMATIC MOLECULES. Johnson, P. M.; Studer, M. C. (State Univ. of New York, Stony Brook). Chem. Phys. Lett.; 18: No. 3, 341-344(1 Feb 1973).

Measurements of relative quantum yields of phosphorescene were made for naphthalene versus perdeuteronaphthalene and for toluene versus perdeuterotoluene, all contained in argon crystals at 20°K. In combination with triplet lifetime measurements these quantum yield ratios give the ratios of radiative triplet decay rates. No radiative deuterium effect is found for toluene and only a small effect is seen in naphthalene in contrast to the rather large radiative deuterium effect seen for naphthalene in EPA by Li and Lim. (auth)

132 RAMAN SPECTRA OF FERROCENE-h_{10} AND -d_{10}: LIBRATIONAL MODES AND COMMENTS UPON PREVIOUS POLARIZATION DATA. Hyams, I. J. (Technion-Israel Inst. of Tech., Haifa). Chem. Phys. Lett.; 18: No. 3, 399-401(1 Feb 1973).

The librational modes of ferrocene-h_{10} and -d_{10} were observed near 62 cm^{-1} (-h_{10}) and 40, 52 and 60 cm^{-1} (-d_{10}). The polarization measurements at low temperatures can give no useful information concerning the vibrational assignment until the low temperature crystal structure is completely determined. (auth)

133 SECONDARY KINETIC DEUTERIUM ISOTOPE EFFECTS IN THE SOLVOLYSIS OF VINYL TRIFLATES. Further Evidence for a Vinylidene Phenonium Ion. Stang, P. J.; Dueber, T. E. (Univ. of Utah, Salt Lake City). J. Amer. Chem. Soc.; 95: No. 8, 2686-2687(18 Apr 1973).

There may be two different kinds of β-deuterium isotope effects in vinyl cations: one where the isotopic substitution is β to the leaving group on an unsaturated carbon, and one where it is β but on an adjacent saturated carbon. A β deuterium isotope effect of the second kind as well as the first example of a kinetic γ deuterium effect in a vinyl cation are reported. The systems investigated are the cis- and trans-3-phenyl-2-buten-2-yl triflates and the 3-methyl-2-buten-2-yl triflate. (DHM)

134 PRIMARY INTERACTION BETWEEN DIARYL KETONE TRIPLETS AND SIMPLE ALKENES. Isotope Effects. Caldwell, R. A.; Sovocool, G. W.; Gajewski, R. P. (Cornell Univ., Ithaca, NY). J. Amer. Chem. Soc.; 95: No. 8, 2549-2557(18 Apr 1973).

The primary interaction between benzophenone triplet and simple alkenes is shown to be irreversible formation of a complex. The complex possesses substantial charge-transfer character, with olefin as donor and ketone as acceptor. The complex has a finite (though undetermined) lifetime. Support for these conclusions derives from kinetic and quantum-yield studies with the isomeric butenes, and most importantly from the comparison of the results of an extensive study of secondary deuterium isotope effects with mechanistic models. (auth)

135 DEUTERIUM ISOTOPE EFFECTS ON THE $^1T \rightarrow {}^0S$ RADIATIONLESS DECAY RATE IN STILBENE. Saltiel, J.; D'Agostino, J. T.; Herkstroeter, W. G.; Saint-Ruf, G.; Buu-Hoi, N. P. (Florida State Univ., Tallahassee). J. Amer. Chem. Soc.; 95: No. 8, 2543-2549(18 Apr 1973).

The effect of azulene on stationary states of the benzophenone-sensitized photoisomerization of vinylsubstituted stilbene-d_2 and aromatic-substituted stilbene-d_{10} was determined in benzene solutions at 298°K. Comparison with previous observations concerning stilbene-d_0 and stilbene-d_{12} leads to the conclusion that deuteration of the vinyl positions increases the effective lifetime of stilbene triplets by 30%, while ring deuteration has no effect. The lifetime increase is tentatively attributed to a change in the radiationless decay rate of twisted stilbene triplets. The positional dependence of the deuterium isotope effect for radiationless decay from transoid triplets was determined by flash kinetic spectrophotometry in 3-methylpentane and isopentane-3-methylpentane glasses at 77°K and in glycerol at 195°K. Once again deuteration at the vinyl positions has the most substantial effect, but in this case some lengthening of the lifetime is also observed upon ring deuteration. This positional dependence of the deuterium isotope effect is in good agreement with previous measurements in EPA at 77°K. The experimental observations are discussed in terms of a previously proposed potential energy curve for twisting about the central bond in the lowest stilbene triplet state, and possible implications of the positional dependence of the deuterium isotope effects are considered in relation to existing theories of radiationless intersystem crossing. (auth)

136 MICROWAVE SPECTRUM, STRUCTURE, DIPOLE MOMENT, AND BARRIER TO INTERNAL ROTATION OF PHOSPHINE-BORANE. Durig, J. R.; Li, Y. S.; Carreira, L. A.; Odom, J. D. (Univ. of South Carolina, Columbia). J. Amer. Chem. Soc.; 95: No. 8, 2491-2496(18 Apr 1973).

The microwave spectra in the P, K, and R bands of 16 isotopic species of phosphine-borane (H_3PBH_3) were measured and the following structural parameters were determined: d(BH) = 1.212 ± 0.002 Å, d(PH) = 1.399 ± 0.003 Å, d(PB) = 1.937 ± 0.005 Å, ∠ BPH = 116.9 ± 0.2°, ∠ PBH = 103.6 ± 0.2°, ∠ HBH = 114.6 ± 0.2°, ∠ HPH = 101.3 ± 0.2°. The molecule was found to be in the staggered conformation. The value of the dipole moment obtained from Stark splittings is 4.00 ± 0.03 D in the ground state and in the first excited state of the torsional mode. The barrier to internal rotation was determined from both the splitting and relative intensity methods to be 2.47 ± 0.05 kcal/mol. The structural parameters and barrier to internal rotation are compared to the corresponding values for similar molecules. (auth)

137 POTENTIAL CONSTANTS OF MANGANESE PENTACARBONYL BROMIDE FROM THE VIBRATIONAL SPECTRA OF ISOTOPIC SPECIES. Ottesen, D. K.; Gray, H. B.; Jones, L. H.; Goldblatt, M. (California Inst. of Tech., Pasadena). Inorg. Chem.; 12: No. 5, 1051-1061(May 1973).

Infrared and Raman spectra are reported for $Mn(^{12}C^{16}O)_5Br$, $Mn(^{13}C^{16}O)_5Br$, and $Mn(^{12}C^{18}O)_5Br$ as solids and in CH_2CL_2 solutions. Most of the fundamental vibrations were definitively assigned. Compliance constants with standard deviations and their equivalent force constants were calculated for a general quadratic valence potential field. Changes in the σ- and π-bonding systems in going from $Cr(CO)_6$ to $Mn(CO)_5Br$ are deduced by a detailed examination of the internal valence potential constants. (auth)

138 KINETIC ISOTOPE EFFECTS IN REACTIONS OF THIOLS WITH RADICALS FORMED BY RADIOLYSIS. Pryor, W. A.; Kneipp, K. G.; Morkved, E. H.; Stanley, J. P. (Louisiana State Univ., Baton Rouge). Radiat. Res.; 53: No. 2, 181-189(Feb 1973).

A novel method is described for determining the kinetic isotope effect on the reaction in which a free radical abstracts a hydrogen atom from a H-donor such as a thiol, RSH. The radical is generated by gamma irradiation of an appropriate precursor, and

the isotope effect is obtained by comparing the results of two experiments: in the first, the radical is allowed to react with tritiated RSH; in the second, the radical reacts with tritium-*labeled RSD. The validity of this system was tested by generating* the cyclohexyl radical in two different ways: radiolysis of cyclohexane and decomposition of the perester $C_6H_5-CO_2-OC_4H_9-t$. The k_H/k_D ratios from these independent methods are in excellent agreement. The utility of the method was demonstrated by ra*diolyzing the ethyl ester of N,N-dimethylglycine. The isotope* effect for abstraction of a hydrogen from thiols by the $(CH_3)_2N-CH-CO_2-Et$ radical produced in this system can be compared *with the data previously reported for other radicals. The N,N-*dimethylglycyl radical, which is a model for radicals produced in the radiation of proteins, appears to be stabilized relative to a secondary alkyl radical. (auth)

139 STERICALLY HINDERED AROMATIC COMPOUNDS. 5. *Solvolysis of p-Methyl-, 2,4,6-Trimethyl-, and 2,4,6-Tri-t-*Butylbenzyl Chloride. Effect of Solvent and α Deuterium Substitution. Barclay, L. R. C.; Mercer, J. R.; Hudson, J. C. (Mount Allison Univ., Sackville, New Brunswick). Can. J. Chem.; 50: No. 24, 3965-3972 (15 Dec 1972).

Rates, activation parameters, and kinetic α-deuterium isotope effects are reported for solvolysis of p-methyl-benzyl chloride in 80% trifluoroethanol–water, and in ethanol–water and t-butyl *alcohol–water of varying solvent compositions. The α-deuterium* isotope effect in trifluoroethanol–water (k_H/k_D = 1.14 per D) indicates approximately limiting behavior. Results in the other solvents (k_H/k_D = 1.04–1.08) indicate considerable nucleophilic participation by solvent in the transition state. 2,4,6-Trimethyl-*benzyl chloride gave k_H/k_D = 1.09 in 80% ethanol–water but* k_H/k_D = 1.16 in 80% trifluoroethanol–water. 2,4,6-Tri-t-butyl-benzyl chloride showed k_H/k_D effects of 1.13 to 1.15 in t-butyl *alcohol–water and 1.15 to 1.16 in ethanol–water. The higher* kinetic isotope effects for solvolysis of these trialkylbenzyl chlorides are discussed in terms of steric hindrance to nucleophilic participation by solvent. NMR chemical shifts give evidence for steric compression of the benzylic protons in 2,4,6-*tri-t-butylbenzyl chlorides. (auth)*

140 DEUTERIUM ISOTOPE EFFECTS IN THE OXIDATION OF 2,3-DIMETHYL-2-BUTENE VIA THE BROMOHYDROPEROXIDE, BY SINGLET OXYGEN AND BY TRIPHENYL PHOSPHITE OZONIDE. Kopecky, K. R.; van de Sande, J. H. (Univ. of *Alberta, Edmonton). Can. J. Chem.; 50: No. 24, 4034-4049* (15 Dec 1972).

The partially deuterated alkenes $(CH_3)_2C{=}C(CD_3)_2$ (1b) and $CH_3CD_3C{=}CCH_3CD_3$ (1c) were prepared and converted to the corresponding allylic hydroperoxides. Two bromohydroperoxides were formed from 1b in a 1.6 : 1 ratio with the major isomer having the OOH group on the carbon bearing the CH_3's. On treatment with base at 0°C this mixture formed two allylic hydroperoxides in a 2.2 : 1 ratio with the major isomer having the OOH group on the carbon bearing the CD_3's, showing migration of the OOH group. This isomer predominated in a 1.4 : 1 ratio when 1b was oxidized with singlet oxygen at 15 or −52°C and in a 1.6 : 1 ratio when 1b was oxidized with triphenyl phosphite ozonide at −70°C. Under the same conditions C–H bond breaking also predominated in the oxidation of 1c, by 2.1 : 1 via the bromohydroperoxide, by 1.4 : 1 with singlet oxygen, and by 1.3 : 1 with triphenyl phosphite ozonide. Migration of the OOH group in the reaction of the bromohydroperoxide of 1b does not occur by way of a 1,2-dioxetane. A perepoxide may be the intermediate. Neither perepoxides nor 1,2-dioxetanes are involved in the singlet oxygen oxidation of 1b and c. At −70°C the triphenyl phosphite ozonide oxidations do not proceed by way of these intermediates, either, or by way of singlet oxygen. The intermolecular deuterium isotope effect in the singlet oxygen oxidation of both cis- and trans-2,3-diphenyl-2-butene was found to be 1.1. (auth)

141 THIOHYDANTOINS. 12. Secondary Deuterium Isotope Effects in the Acid- and Base-Catalyzed Hydrolysis of 1-Acetyl-5,5-Dimethyl-2-Thiohydantoin. Congdon, W. I.; Edward, J. T. (McGill Univ., Montreal). Can. J. Chem.; 50: No. 23, 3921-3923 (1 Dec 1972).

The rates of hydrolysis of 1-acetyl-5,5-dimethyl-2-thiohydantoin and of 1-acetyl-d_3-5,5-dimethyl-2-thiohydantoin in acid and base over the temperature range 11 to 58°C were measured. For the A-1 hydrolysis in 96.3% sulfuric acid, k_H/k_D decreased from 1.31 at 10.8°C to 1.05 at 58.1°C; these results accord with the proposed mechanism. For A-2 hydrolysis in 39.6% sulfuric acid and for base-catalyzed hydrolysis in dilute sodium hydroxide, k_H/k_D vs. temperature passed through a minimum at about 40 and 25°C respectively. Some possible reasons for the temperature effect are discussed. (auth)

Isotope Exchange and Isotope Separation

142 HOMOGENEOUS CATALYSIS OF D_2-H_2O ISOTOPE EXCHANGE BY PENTACYANOCOBALTATE(II). Strathdee, G. G.; Quinn, M. J. (Atomic Energy of Canada Ltd., Pinawa, Manitoba). *Can. J. Chem.; 50: No. 19, 3144-3153 (1 Oct 1972).*

The rate of exchange of deuterium between hydrogen gas and water catalyzed by pentacyanocobaltate(II) was measured as a func*tion of pressure and temperature at a constant total cobalt concen*tration, 0.05M, and ionic strength, 1M. The rates of evolution of hydrogen from solutions of hydridopentacyanocobaltate(III) were *determined under identical conditions. These data were used to* test the validity of a mechanism for the $Co(CN)_5^{3-}$-catalyzed isotope exchange reaction, and to clarify the controversy over the magnitude of the specific rate for the deuterium transfer step $DCo(CN)_5^{3-} + H_2O \xrightarrow{k_D} HCo(CN)_5^{3-} + HDO$. Calculations show that *kinetic isotope and ion pairing effects are significant. (auth)*

143 ROUTES TO FUNCTIONALIZED QUANIDINES. The *Synthesis of Guanidino Diesters. Bosin, T. R.; Hanson, R. N.;* Rodricks, J. V.; Simpson, R. A.; Rapoport, H. (Univ. of California, Berkeley). J. Org. Chem.; 38: No. 8, 1591-1600 (20 Apr 1973).

*Six general methods for the synthesis of acyclic and cyclic guani*dines, bearing a variety of substituents, are described. These guanidines may be symmetrical or unsymmetrical, and the sub*stituents they bear provide the basis for further chemical manip*ulation. The acyclic guanidines are derived from single carbon intermediates and the appropriately substituted amine. The cyclic guanidines result from the functionalization of a 2-p-toluenesulfonamidopyrimidine which is subsequently hydrogenated. Use of the *tosyl as a protecting group reduces the effects of the strongly alka*line guanidine moiety, and its facile removal is achieved with hydrogen fluoride. These imidazolinones underwent deuterium ex*change for which a mechanism involving the formation of a* mesoionic intermediate is proposed. (auth)

144 *ISOTOPIC EXCHANGE REACTIONS BETWEEN Tl(III)* IN COMPLEX COMPOUNDS OF THE TYPE $[HTlBr_4]$. Pyridine base and $^{204}Tl(I)$. Cecal, A.; Schneider, I. A. (Univ., Iasi). *J. Inorg. Nucl. Chem.; 35: No. 5, 1565-1569 (May 1973).*

A study was made of the kinetics of the electron-transfer *isotopic exchange reactions between trivalent thallium in ad*dition complexes of the type $[HTlBr_4]$. py (py = pyridine base) type and simple monovalent thallium, $^{204}Tl(I)$. Effects of *different substituents in the pyridine ring on the exchange re*action parameters in the given system were established. The bases pyridine, α-picoline, 2,4-lutidine, collidine and quinoline were used in the complex compounds. (auth)

145 NEW METHOD OF PRODUCING PURINE NUCLEOTIDES *WITH A FIXED TRITIUM LABEL. Vdovenko, V. M.; Bobrova, V.* N.; Gordeeva, L. S.; Dedova, V. K. Sov. Radiochem. (Engl. Transl.); 14: No. 3, 464-468 (1972).

Translated from Radiokhimiya; 14: No. 3, 457-462 (1972).

A method was developed for the synthesis of adenosine-8-^{3}H-5′-monophosphate (lithium salt) by a reductive dehalogenation of 8-bromoadenosine-5′-monophosphate with gaseous tritium over a catalyst of 5% Pd/C. The latter was produced by phosphorylation of 8-bromo-2′,3′-O-isopropylidene-adenosine with pyrophosphoryl chloride. Adenosine-8-^{3}H-5′-monophosphate (lithium salt) with a specific activity of 5 Ci/mmole (~10 Ci/g), 97% radiochemical purity, was synthesized. (auth)

146 CATALYSIS OF α-HYDROGEN EXCHANGE. XIII. Bifunctional Catalysis of the Dedeuteration of Isobutyraldehyde-2-d by Polyethylenimines. Hine, J.; Glod, E. F.; Notari, R. E.; Rogers, F. E.; Schmalstieg, F. C. (Ohio State Univ., Columbus). J. Amer. Chem. Soc.; 95: No. 8, 2537-2543 (18 Apr 1973).

Catalysis of the dedeuteration of isobutyraldehyde-2-d by polyethylenimines (PEI's) in aqueous solution is interpreted in terms of the reversible transformation of the aldehyde to an iminium ion by a primary amino group on the polymer followed by rate-controlling internal removal of a deuteron by another amino group in the same molecule. The pseudo-first-order rate constant for the reaction of aldehyde at a given concentration increases with increasing PEI concentration at first and then levels off as the aldehyde becomes completely complexed. Analogously, the rate of reaction at a given concentration of PEI increases with increasing aldehyde concentration and then levels off. The amount of aldehyde complexed under various conditions is followed by uv measurements. The catalytic activities of PEI's with molecular weights in the range 600 to 1800 are (on a per amino group basis) similar and are 12 to 36 times those of ethylenediamine and its various N-ethyl derivatives, model compounds that cannot act as bifunctional catalysts. Poly(N-ethylaziridine), a polymeric tertiary amine, is a much poorer catalyst. The catalytic efficiency of PEI-1800 is at a maximum near pH 8. Added 1,4-diazabicyclo

[2.2.2]octane or 3-quinuclidinone increases the rate of dedeuteration of the aldehyde in the presence of excess PEI by attacking the aldehyde that is complexed as iminium ions; added disodium phosphate is ineffective. Lauroylating the PEI to increase the effectiveness of complexing the aldehyde is also ineffective. (auth)

147 PREPARATION OF [^{14}C] TRIETHYLALUMINIUM. Ayrey, G. (London Univ.); Mazza, R. J. J. Label. Compounds; 8: No. 4, 677-686(1972).

A method for the preparation of [^{14}C] triethylaluminium by catalysed exchange of [^{14}C] ethylene with inactive triethylaluminium is described. Novel methods for handling this spontaneously inflammable substance were developed and used for hydrolytic and radiochemical analyses. (auth)

148 LABELLING OF ELEMENTARY IODINE WITH RADIOIODINE BY HETEROGENEOUS ISOTOPIC EXCHANGE. Toth, G.; Miller, J. (Magyar Tudomanyos Akademia Izotop Intezete, Budapest). Int. J. Appl. Radiat. Isotop.; 24: No. 3, 187-188(Mar 1973).

A method is described of labelling elementary iodine with ^{131}I or ^{125}I, based on heterogeneous isotopic exchange between iodine adsorbed on platinum and elementary iodine in a solution of suitable composition. The advantages of the method are, on the one hand that the labelled iodine solution is not contaminated by either oxidizing agent or iodide ions, and on the other, that the choice of pH interval and solvent is much wider than is the case with oxidation reactions. Labelling yields are tabulated from which it is seen that the labelling efficiency can range from 51 to 96.5% within 100 min depending on the solvent used. (UK)

Feed Materials Processing

Refer also to abstract 357.

Radiation Chemistry

Refer also to abstracts 138, 221, 618, 619, 631, and 632.

149 (CEA-CONF-2229) RADIOLYTIC AND PHOTOLYTIC FORMATION OF STABLE e^-_{am} AMIDE SOLUTIONS. Belloni, J.; Saito, E. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). [nd]. 22p. (CONF-720681-1). Dep. NTIS (U. S. Sales Only) $3.25.

From 3rd Weyl Conference; Tel Aviv, Israel (19 Jun 1972).

It has already been shown that the presence of hydrogen in solutions of amide ions in liquid ammonia hinders the disappearance of the ammoniated electrons. This property was used to measure the yield of formation of solvated electrons in the radiolysis of liquid ammonia, and in the photolysis of the anion NH_2^- in this solvent. The results obtained by varying the dose, the concentration of KNH_2 and the hydrogen pressure are interpreted on the basis of a competition between the ionization of the radical NH_2, giving NH^-, and its reaction with e^-_{am}. This mechanism implies that the reactivity of NH_2 towards H_2 is much weaker than that of its ionized form, NH^-. The ratio can then be determined of the rate constants $k_{(e^-+NH_3)}/k'_{(NH^-+NH_3)} = 1.5 \times 10^5$ and, from the limiting value of $G(e^-_{am})$ at high amide concentrations, the primary radiolytic yield $G_{e^-_{am}} = 1.9$. These values are discussed in relation to the literature data concerning the liquid ammonia and other polar solvents. (auth)

150 (CEA-CONF-2230) CHEMICAL EQUILIBRIA BETWEEN ANIONS AND THE AMMONIATED ELECTRON. Belloni, J.; Saito, E. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). [nd]. 8p. (CONF-720681-2). Dep. NTIS (U. S. Sales Only) $3.00.

From 3rd Weyl conference; Tel Aviv, Israel (19 Jun 1972).

It is well known that the decomposition of solutions of metals in liquid ammonia is limited by the reverse reaction between the amide ion and hydrogen gas leading to the formation of solvated electrons. It was shown that such an equilibrium may exist between other anions and the solvated electrons in the presence of hydrogen. (auth)

151 STRUCTURE OF RADICALS PRODUCED BY γ-RADIOLYSIS. Part 2. Radicals Derived from 5-Membered Alicyclic Molecules. Linder, R. E.; Ling, A. C. (West Virginia Univ., Morgantown). Can. J. Chem.; 50: No. 24, 3982-3987(15 Dec 1972).

Data are presented for the results of γ radiolysis on cyclopentane, methyl cyclopentane, cyclopentene, and cyclopentadiene, held as solutes in adamantane matrices. Data from this particular matrix isolation technique are in accord with liquid phase studies for cyclopentane and cyclopentene, and indicate that tertiary hydrogen loss occurs in methyl cyclopentane, and that cyclopentadiene yields at least three radicals. Two of the radicals derived from cyclopentadiene were identified as the $C_5H_5\cdot$ entity with five equivalent protons, and the allylic-type radical formed by hydrogen atom addition to molecular C_5H_6. (auth)

152 SYNTHESIS AND INVESTIGATION OF COLORED POLYACRYLONITRILE OBTAINED IN THE PRESENCE OF VINYL SULFONIC DYES. Ryasnoi, V. D.; Arkhiptsev, V. M.; Salamatov, I. I.; Petryaev, E. P. (Inst. of Nuclear Energy, Minsk). Vestsi Akad. Navuk Belarus. SSR, Ser. Fiz.-Energ. Navuk; No. 2, 24-28 (1972). (In Russian).

The synthesis of dyed polyacrylonitrile by polymerization of acrylonitrile in aqueous solution combined with vinyl sulfonic dyes is described. The mixture of acrylonitrile and vinyl sulfonic dye was irradiated using ^{60}Co γ rays. The influence of factors of polymerization on the yield and viscosity of the colored polymer was studied. Results of spectrophotometric studies of initial dye and colored polyacrylonitrile are reported. (auth)

153 PRODUCTION OF COMBINED FIBROUS ION EXCHANGER BY LIQUID-PHASE COPOLYMERIZATION OF STYRENE WITH DIVINYLBENZENE ON POLYPROPYLENE FIBERS. Kapustina, I. B.; Kurilenko, A. I.; Kosenko, T. V.; Khoroshko, R. P. (Inst. of Nuclear Energy, Minsk). Vestsi Akad. Navuk Belarus. SSR, Ser. Fiz.-Energ. Navuk; No. 2, 29-32(1972). (In Russian).

The copolymerization of styrene with divinylbenzene on polypropylene in the presence of methanol was studied. The copolymerization was induced with 2% by weight of benzoyl peroxide at 70°C and by ^{60}Co gamma radiation at 100 R/sec. Dependence of copolymerization of the monomer mixture was established. Properties of fiber ionites obtained on the basis of copolymer of styrene with divinylbenzene on polypropylene fibers were studied. (KSW)

154 ELECTRONS IN LIQUID ALCOHOLS AT LOW TEMPERATURES. Baxendale, J. H.; Wardman, P. (Univ. of Manchester, Eng.). J. Chem. Soc., Faraday Trans., I; 69: No. 3, 584-594(1973).

Pulse radiolysis, with 10 to 12 MeV electrons, was used to study the electrons in alcohols at temperatures near their melting points. The solvated electrons show absorption spectra in the far and infrared which, in general, decay to produce increased absorptions in the visible. At these temperatures the time for these changes increases in the order methanol, ethanol, n-butyl, isopropyl, n-propyl alcohol. For the latter the half-life of the absorption decay is given by $\tau_s = A \exp E/RT$ where $\log_{10} A = -15.7$ and $E = 25$ kJ (5.9 kcal). Addition of solutes which react with electrons decreases the initial ir absorption and is interpreted as reaction with electrons before they become solvated. The observations are discussed in terms of molecular relaxation and electron migration. (auth)

155 ^{60}Co γ RAY PREPARATION OF ETHYLDIGERMANE. Khandelwal, J. K.; Pinson, J. W. (Univ. of Southern Mississippi, Hattiesburg). Inorg. Nucl. Chem. Lett.; 9: No. 4, 393-397(Apr 1973).

The preparation of ethyldigermane has been carried out by various methods and under varied experimental conditions. None of them, however, appears to be quick and selective. The γ-induced preparation described appears to be more selective and expedient. (auth)

156 SPATIAL NONUNIFORMITY IN THE FORMATION AND DESTRUCTION OF INTERMEDIATE RADIOLYSIS PRODUCTS. Bugaenko, L. T.; Byakov, V. M.; Lebedev, Ya. S. (Moscow State Univ.). High Energy Chem. (USSR) (Engl. Transl.); 6: No. 4, 285-296(1972).

Translated from Khim. Vys. Energ.; 6: No. 4, 327-340(1972).

Factors determining the spatial distribution of primary and secondary radiolysis products in liquid and solid substances are reviewed. Track effects, caused by the spatial inhomogeneity of the physical act of radiolysis itself, are of primary significance in the radiolysis of aqueous solutions. In the radiolysis of solids, the roles of cage effect, track effect, and structural inhomogeneity of the matrix are discussed. (JGB)

157 INVESTIGATION OF GAMMA-RAY INDUCED POLYMER FORMATION IN THE CARBORANES. 3. Factors Which Limit the Molecular Weight of the 1-vinyl-o-carborane Polymer. Klingen, T. J.; Wright, J. R. (Univ. of Mississippi, University). J. Inorg. Nucl. Chem.; 35: No. 5, 1451-1456(May 1973).

The polymerization of 1-vinyl-o-carborane was investigated in both the pure bulk material and in cyclohexane solution. The results in both cases indicate that the primary mechanism of polymerization is free radical. In the case of the pure bulk 1-vinyl-o-carborane polymerization, the principal factor which limits $\overline{Dp}_n$ was found to be chain transfer. The propagation rate constant in the pure material was determined to be approximately $2 \times 10^2 M^{-1}$ sec^{-1} with an E_a of 3.3 kcal/mole. Polymerization of 1-vinyl-o-carborane in cyclohexane solution results in both the $G_{(-m)}$ and Dp_n being greatly reduced compared to the values obtained in the pure bulk material. (auth)

158 COMPOSITION OF γ-INITIATED TELOMERIZATION PRODUCTS OF ETHYLENE WITH PRIMARY ALCOHOLS. Zago-

rets, P. A.; Shostenko, A. G.; Dodonov, A. M. (Moscow Inst. of Chemical Tech.). High Energy Chem. (USSR) (Engl. Transl.); 6: No. 4, 334-335(1972).

Translated from Khim. Vys. Energ.; 6: No. 4, 378-379(1972).

The identification of telomers in the ethylene γ-initiated telomerization reaction with methanol, ethanol, propanol, butanol, and pentanol was carried out. Formation of a series of rearranged products was observed for all alcohols investigated. Analysis and identification of reaction products was achieved by gas chromatography. (JGB)

159 MECHANISM OF THE EFFECT OF ALKALI ADMIXTURES ON γ RADIOLYSIS OF CRYSTALLINE NITRATES. Zhukova, T. N.; Ershov, B. G.; Pikaev, A. K. (Inst. of Physical Chemistry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 6: No. 4, 332-333(1972).

Translated from Khim. Vys. Energ.; 6: No. 4, 376-378(1972).

Studies were conducted on the radiation yields of NO_2^- and paramagnetic centers that appear during γ radiolysis at 25° and −196°C of $LiNO_3$, $NaNO_3$, and KNO_3, with and without corresponding hydroxides. Dose rate was 5.6×10^{16} eV/g · sec. Addition of OH^- greatly increased $G(NO_2^-)$ for all the nitrates investigated, the increase depending on the size of the cation. Admixtures of the alkalis were found to have practically no effect on NO_3 radical yields. Temperature effects are reported. (JGB)

160 ESR SPECTRA OF γ-IRRADIATED FROZEN FORMIC ACID. Taranukha, O. M.; Lebedev, Ya. S. (Inst. of Chemistry of High Molecular Weight Compounds, Kiev). High Energy Chem. (USSR) (Engl. Transl.); 6: No. 4, 328-329(1972).

Translated from Khim. Vys. Energ.; 6: No. 4, 374-375(1972).

It is reported that the ESR signal that arises during the γ irradiation of frozen chemically pure formic acid depends on the phase state of the sample. Glassy samples, γ-irradiated at 77°K, exhibited an asymmetric doublet that is characteristic for uniaxial anisotropy of the g-factor. Results are compared with those from previous ESR studies on polycrystalline and amorphous samples. (JGB)

161 THERMOLUMINESCENCE OF POLY-3-METHYLBUTENE-1 AFTER EXPOSURE TO X RAYS AND ULTRAVIOLET LIGHT. Korobeinikova, V. N.; Kazokov, V. P.; Minsker, K. S.; Soldaeva, N. P. (Inst. of Chemistry, Bashkir, USSR). High Energy Chem. (USSR) (Engl. Transl.); 6: No. 4, 326-327(1972).

Translated from Khim. Vys. Energ.; 6: No. 4, 372-373(1972).

Thermoluminescence (TL) curves are given for highly crystalline poly-3-methylbutylene after exposure to uv radiation, after exposure to x rays, and after consecutive exposure to x rays and then uv radiation. Peaks or inflections occur at 109°, 115°, 125°, 140°, 150°, 167°, 205°, 210°, and 230°K. It is noted that consecutive exposure to two types of radiation does not lead to the appearance of new TL maxima, and that the low-temperature peaks disappear after exposure to uv radiation. (JGB)

162 RADIATION YIELD OF NITRITE IONS IN CONCENTRATED NITRATE SOLUTIONS FOR NEUTRONS OF VARIOUS ENERGIES. Tkachenko, V. V.; Maloletko, A. V.; Khovanovich, A. I. (Inst. of Physical Chemistry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 6: No. 4, 324-325(1972).

Translated from Khim. Vys. Energ.; 6: No. 4, 371-372(1972).

Radiation yields of nitrite ions in concentrated (320 g/liter and 640 g/liter) solutions of ammonium nitrate for neutrons of various energies for a range of doses exceeding 10^{16} eV/cm^3 were measured. Radioinduced yields G_n and changes in optical density of nitrate solutions (ΔS_n) at a unit dose of neutrons (D_n) and a layer thickness of the solutions are tabulated. Results indicate that for a broad range of neutron energies ($E \simeq 5$ MeV) the radiation yield of nitrite ions for the investigated ammonium nitrate concentrations remains virtually constant and less than for those produced by γ irradiation and reported previously. The significant increase in values of G_n for neutrons having E = 14.1 is possibly associated with interaction of high-energy neutrons with the medium. (JGB)

163 EFFECT OF PREIRRADIATION ON THE CATALYTIC PROPERTIES OF ZEOLITES USED FOR ISOBUTYLENE CONVERSION. Panchenko, G. M.; Guseinov, A. M. D.; Kuznetsov, O. I.; Berezovskaya, E. N. High Energy Chem. (USSR) (Engl. Transl.); 6: No. 4, 316-320(1972).

Translated from Khim. Vys. Energ.; 6: No. 4, 362-367(1972).

Results are given for an investigation of the effect of γ irradiation (dose 40 Mrad) on the catalytic properties of NaX, NaY, LiX, LiY, CaX, and CaY zeolites for the conversion of isobutylene. It is shown that preirradiation of the zeolites increases the isobutylene conversion, the yields of individual isobutylene dimers, and the isomerization activity. Preliminary γ irradiation of CaX and CaY zeolites controls the yield of an unwanted product (isobutane). (auth)

164 ELECTRONIC ACTS OF RADIATION ADSORPTION AND RADIATION–HETEROGENEOUS CATALYSIS. Kotov, A. G.; Pshezhetskii, S. Ya. (Inst. of Physical Chemistry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 6: No. 4, 297-307 (1972).

Translated from Khim. Vys. Energ.; 6: No. 4, 341-352(1972).

Radiation–heterogeneous processes take place under the action of ionizing radiation at the boundary of two phases, one of which is a solid. Various studies are reviewed dealing with the two basic components of this process, radiation adsorption and chemical transformations of adsorbed molecules. It is shown that the basic elementary process that ensures energy transfer from sorbent to sorbate is the recombination mechanism, that is, energy transfer by means of nonequilibrium charges. (JGB)

165 REACTIONS OF ELECTRONICALLY EXCITED ATOMS AND MOLECULES. Kupriyanov, S. E. (Physical-Chemical Inst., Moscow). High Energy Chem. (USSR) (Engl. Transl.); 6: No. 4, 266-275(1972).

Translated from Khim. Vys. Energ.; 6: No. 4, 304-315(1972).

A brief review is given of new work in which experimental investigations have been performed under conditions of low pressures (~10^{-4} to 10^3 torr) and low kinetic energies (thermal) of the interacting particles. Such conditions are due to the specific nature of the experiment (single nature of the collision, formation of excited particles from gaseous targets, etc.). This places strict requirements on the lifetime of the excited particles. They must be comparatively long ($\gtrsim 10^{-6}$ sec). Of course, under other conditions (high pressures) short-lived excited particles, the probability of which in collisions of electrons and, particularly, photons with atoms and molecules is far greater, also take part in this type of processes. The reactions considered with the participation of electronically-excited atoms and molecules are widely distributed in nature and play an important part in many phenomena. (auth)

166 ESR SPECTRUM OF A HYDRAZYL ($RNNH_2$) RADICAL. Muszkat, L. (Weizmann Inst. of Science, Rehovot, Israel). Chem. Phys. Lett.; 18: No. 3, 414-416(1 Feb 1973).

An ESR study of γ-irradiated single crystals of cyanoacetyl hydrazide indicates that the free radical formed is the corresponding hydrazyl ($NCCH_2CONNH_2$), in which a large fraction of the unpaired spin density is located on the α-nitrogen atom. (auth)

167 COMPUTER PROGRAMMING PROBLEMS OF THE DIFFUSION KINETIC MODEL OF THE INDIRECT ACTION OF RADIATION. Peil, A.; Peil, J. (Humboldt Univ., Berlin). Stud. Biophys.; 34: No. 1, 31-42(1972). (In GC).

The LET dependence of the radioinduced decomposition of SH-substances in dilute aqueous solutions suggests as the interpretation of this indirect effect of radiation the application of diffusion-kinetic model conceptions. Quantitative connections in the form of a system of simultaneous, nonlinear, and partial differential equations contained in this model are prepared for a numerical calculation on a digital computer. In this preparation the following problems, which are partially connected, arise: the physical relevance of the model parameters (e.g. diffusion coefficients and rate constants, number and distribution of radicals) as well as of the results (e.g., G values); mathematical-numerical problems (e.g. choice of the values of the mesh parameters, exactness and stability of the procedure); and, important aspects of computational technique which determine the practical usefulness of the programmed algorithm (e.g., automatic increase in these values of the mesh parameters, program interruptions). Some of these problems became evident by computing tests with a program worked out for the digital computer ZRA 1; these calculations also suggested possible solutions. The numerical results of the computing tests are stated in order to clarify means for overcoming these difficulties. (auth)

168 CHLORIDES OF TELLURIUM. II. Radiation Damage of Solid Tellurium Tetrachloride Irradiated by 600 MeV Protons. Christensen, G. C.; Alstad, J. (Univ. of Oslo). Radiochem. Radioanal. Lett.; 13: No. 4, 235-244(27 Apr 1973).

The decomposition of solid tellurium tetrachloride was investigated by the use of the combined methods of micro filtration and neutron activation analysis. Non-irradiated and irradiated (by 600-MeV protons) tellurium tetrachloride were analyzed, and a lower limit of 60 μg Te/g $TeCl_4$ was found in both. Results indicate that the radiolytic decomposition is negligible compared to other types of decomposition. An estimation of the pure radiolytic decomposition shows good agreement with experimental data. (auth)

169 RADIATION CHEMISTRY OF NUCLEIC ACIDS. Isolation and Characterization of Glycols of 1 Carbamylimidazolidone as Products of Cytosine. Hahn, B. S. (Johns Hopkins Univ., Baltimore); Wang, S. Y. Flippen, J. L.; Karle, I. L. J. Amer. Chem. Soc.; 95: No. 8, 2711-2712(18 Apr 1973).

The isolation of two polymeric products (G value 0.075) obtained from the radiolysis of cytosine in aerated aqueous solutions is reported. The products characterized by spectral and x-ray diffraction analyses are identified as cis- and trans-1-carbamylimidazolidone-4,5-diols. (DHM)

170 ELECTRON SPIN RESONANCE STUDY OF SOME SILICON-, GERMANIUM-, AND TIN-CENTERED RADICALS. Lloyd, R. V.; Rogers, M. T. (Michigan State Univ., East Lansing). J. Amer. Chem. Soc.; 95: No. 8, 2459-2464(18 Apr 1973).

The radicals $\cdot Sn(CH_3)_nCl_{3-n}$ (n = 0, 1, 2, 3), $\cdot GeCl_3$, and $\cdot SiCl_3$ were prepared in either an adamantane matrix or the self-matrix by ^{60}Co γ irradiation and studied by ESR spectroscopy. Anisotropic spectra were obtained for the two mixed chloromethylstannyl radicals but only isotropic spectra for the others; the observable ESR parameters were evaluated in each case. The structures of the radicals were discussed on the basis of the ESR data, and these results, along with appropriate values from the literature, permitted a comparative study of the chloro and methyl radicals of the group IVa elements. The series $\cdot M(CH_3)_3$ and $\cdot MH_3$ (M = Si, Ge, Sn) both appear to be strongly bent with not greatly different geometries. The carbon-centered analogs, on the other hand, vary from planar [$\cdot CH_3$] to a distortion of about 8 to 10° from planar [$\cdot CCl_3$] with the $\cdot C(CH_3)_3$ intermediate between these. It is found that the g values increase from carbon to tin in the $\cdot M(CH_3)_3$ series but decrease in the $\cdot MCl_3$ series. This surprising result indicates that ligand spin–orbit coupling from (d-p)π bonding involving chlorine is important in the latter series. (auth)

171 ACID–BASE PROPERTIES OF RADICAL ANIONS OF CIS AND TRANS ISOMERS. I. Fumarates and Maleates. Hayon, E.; Simic, M. (Army Natick Labs., MA). J. Amer. Chem. Soc.; 95: No. 8, 2433-2439(18 Apr 1973).

The radical anions of dimethyl fumarate (DMF) and dimethyl maleate (DMM) were produced in aqueous solutions directly by reaction with solvated electrons, e.g., e^-_{aq} + DMF → $\cdot DMF^-$, or by electron transfer from an organic free radical, e.g., $(CH_3)_2\dot{C}OH$ + DMF → $\cdot DMF^-$ + CH_3COCH_3 + H^+. The $\cdot DMF^-$ and $\cdot DMM^-$ radicals have absorption maxima at 335 and 350 nm, extinction coefficients 2.2×10^4 and 1.45×10^4 M^{-1} cm^{-1}, and decay constants $2k = 2.9 \times 10^8$ and 2.5×10^8 M^{-1} sec^{-1}, respectively. The spectral characteristics of the radical anions are compared with those of the parent compounds in the ground state. In acidic solutions, the transient optical spectra are blue-shifted, producing the characteristic spectral shift of the protonated radicals $\cdot DMF^- - H^+$ and $\cdot DMM^- - H^+$, with maxima at 320 and 342 nm and extinction coefficients of 2.0×10^4 and 1.25×10^4 M^{-1} cm^{-1}, respectively. The acid–base properties of these radicals were studied, and a pK_a of 2.8 ± 0.1 for the trans radical compared with 4.8 ± 0.1 for the cis radical was observed. The strong resonance of these radicals leading to various hybrid structures is somewhat reduced in monomethyl fumarate (MMF), giving a pK_a = 11.5 ± 0.2 for the dissociation of $\cdot MMF^- - H^+$ (λ_{max} 335 nm, ϵ 1.5×10^4 M^{-1} cm^{-1}) to the radical anion $\cdot MMF^-$ (λ_{max} 345 nm, ϵ 1.4×10^4 M^{-1} cm^{-1}). The radical anions of fumaric (FH_2) and maleic (MH_2) acids have different absorption spectra and dissociation constants which are also dependent on the state of protonation of the carboxyl groups. For the dianion F^{2-}, the radical $\cdot F^3 - H^+$ (λ_{max} 333 nm, ϵ 2.7×10^4 M^{-1} cm^{-1}) has a $pK_a \sim 10.9$ forming the anion $\cdot F^{3-}$ (λ_{max} 340 nm and ϵ 2.6×10^4 M^{-1} cm^{-1}). For M^{2-}, the radical $\cdot M^{3-} - H^+$ has a maximum at 348 nm and ϵ 1.7×10^4 M^{-1} cm^{-1}, but no acid–base dissociation could be observed up to pH ~ 13.5. These results are discussed and possible implications to electron transfer reactions and cis–trans isomerization of biological systems are presented. (auth)

172 RADIATION CHEMISTRY OF MACROMOLECULES. Volume II. Dole, M. (ed.). New York; Academic Press, Inc. (1973). 420p.

The review is presented in four sections: radiation chemistry of substituted vinyl polymers; radiation chemistry of some miscellaneous polymers; effect of radiation on oxidation, mechanical properties, and physical state; and macromolecules of biological interest. Each of the seventeen chapters has been abstracted separately for NSA. (JGB)

For abstracts of individual chapters see: 173–189.

173 POLYPROPYLENE. Geymer, D. O. (Shell Development Co., Houston, TX). pp 3-28 of Radiation Chemistry of Macromolecules. Vol. II. Dole, M. (ed.). New York; Academic Press, Inc. (1973).

The radiation chemistry of polypropylene is discussed under the following section headings: gas evolution and unsaturation, production of free radicals and their reactions other than cross-linking and chain scission, thermoluminescence and electron trapping, and effects of radiation on ethylene–propylene rubber. (98 references) (JGB)

174 POLY(PROPYLENE OXIDE). Dole, M. (Baylor Univ., Waco, TX). pp 29-36 of Radiation Chemistry of Macromolecules. Vol. II. Dole, M. (ed.). New York; Academic Press, Inc. (1973).

The radiation chemistry of poly(propylene oxide) is discussed under the following section headings: introductory survey and table of G values, hydrogen and methane evolution, chain scission, cross-linking, and transient species. (20 references) (JGB)

175 POLY(VINYL CHLORIDE). Salovey, R. (Hooker Research Center, Niagara Falls, NY). pp 37-45 of Radiation Chemistry of Macromolecules. Vol. II. Dole, M. (ed.). New York; Academic Press, Inc. (1973).

The radiation chemistry of poly(vinyl chloride) is discussed under the following section headings: hydrogen chloride evolution, polyene formation, free radicals, relation to thermal degradation, and physical properties. (22 references) (JGB)

176 POLYVINYL ACETATE. Graessley, W. W. (Northwestern Univ., Evanston, IL). pp 47-55 of Radiation Chemistry of Macromolecules. Vol. II. Dole, M. (ed.). New York; Academic Press, Inc. (1973).

The radiation chemistry of polyvinyl acetate is reviewed under the following subject headings: cross-linking and random scission, trapped free radicals, ultraviolet and infrared spectroscopy, gas evolution, and effects of branching and copolymerization. (JGB)

177 POLYSTYRENE AND RELATED POLYMERS. Parkinson, W. W. (Oak Ridge National Lab., TN). pp 57-96 of Radiation Chemistry of Macromolecules. Vol. II. Dole, M. (ed.). New York; Academic Press, Inc. (1973).

The radiation chemistry of polystyrene and its related polymers is reviewed as to primary processes and mechanisms, radioinduced reactions, radioinduced changes in physical properties, and copolymers. (84 references) (JGB)

178 POLYMERS THAT PRIMARILY DEGRADE ON IRRADIATION. Dole, M. (Baylor Univ., Waco, TX). pp 97-117 of Radiation Chemistry of Macromolecules. Vol. II. Dole, M. (ed.). New York; Academic Press, Inc. (1973).

Factors that promote degradation, those that inhibit cross-linking, and the experimental determination of G values for main chain fracture in the radiation chemistry of nongelling polymers are reviewed. The two most important of the nongelling polymers, poly(methyl methacrylate) and poly(isobutylene), are discussed as to radioinduced chemical yields, ultraviolet studies, and mechanisms. In the case of poly(methyl methacrylate), free radical studies are also reviewed. (41 references) (JGB)

179 POLYAMIDES. Zimmerman, J. (E. I. du Pont de Nemours and Co., Inc., Wilmington, DE). pp 121-135 of Radiation Chemistry of Macromolecules. Vol. II. Dole, M. (ed.). New York; Academic Press, Inc. (1973).

The radiation chemistry of polyamides is reviewed under the following subject headings: irradiation products, free radicals, free radical formation and termination, postirradiation diffusion of oxygen, degradation and cross-linking, irradiation grafting, and property changes attainable through radiation grafting. (49 references) (JGB)

180 POLYETHYLENE TEREPHTHALATE. Turner, D. T. (Univ. of North Carolina, Chapel Hill). pp 137-166 of Radiation Chemistry of Macromolecules. Vol. II. Dole, M. (ed.). New York; Academic Press, Inc. (1973).

The radiation chemistry of polyethylene terephthalate is discussed under the following subject headings: charged species, free radicals, reaction products, factors which may affect the product and mechanisms. (52 references) (JGB)

181 FLUOROPOLYMERS. Dole, M. (Baylor Univ., Waco, TX). pp 167-177 of Radiation Chemistry of Macromolecules. Vol. II. Dole, M. (ed.). New York; Academic Press, Inc. (1973).

In this review emphasis is placed on the radiation chemistry of polytetrafluoroethylene(PTFE), because of the importance of radiological studies on this fluoro polymer. Radiation effects on crystallinity, mechanical strength, and elongation are discussed. Reaction mechanisms, cross-linking, and free radicals in irradiated PTFE are also discussed. (24 references) (JGB)

182 POLYSILOXANES. Miller, A. A. (General Electric Research and Development Center, Schenectady, NY). pp 179-185 of Radiation Chemistry of Macromolecules. Vol. II. Dole, M. (ed.). New York; Academic Press, Inc. (1973).

The radiolysis of polydimethylsiloxane, in the pure state and with additives, is reviewed. The radiation chemistry of phenylmethylsiloxanes and filled polysiloxane systems is also discussed. (31 references) (JGB)

183 POLYOXYMETHYLENE. Dole, M. (Baylor Univ., Waco, TX). pp 187-194 of Radiation Chemistry of Macromol-

ecules. Vol. II. Dole, M. (ed.). New York; Academic Press, Inc. (1973).

The radiation chemistry of polyoxymethylene is reviewed briefly. Material balance and kinetics of free radical decay are given particular emphasis. (11 references) (JGB)

184 RADIATION CHEMISTRY OF ELASTOMERS. Boehm, G. G. A. (Firestone Tire and Rubber Co., Westbury, NY). pp 195-260 of Radiation Chemistry of Macromolecules. Vol. II. Dole, M. (ed.). New York; Academic Press, Inc. (1973).

The radiation chemistry of elastomers is reviewed under the following chapter titles: characterization of elastomers, including sections on natural rubber and synthetic elastomers; general, including sections on macro- and microstructure, cross-linking and its promotion by additives, retardation of cross-linking by antirads, and physical properties of radiation-cured elastomers; polyisoprene(natural rubber), including sections on transient intermediates, gas evolution, changes in microstructure, cross-linking, and physical properties; and polyisobutylene and copolymers, including sections on transient intermediates, gas evolution, changes in microstructure, degradation and cross-linking, and physical properties. (175 references) (JGB)

185 OXIDATION OF IRRADIATED POLYMERS. Dole, M. (Baylor Univ., Waco, TX). pp 263-279 of Radiation Chemistry of Macromolecules. Vol. II. Dole, M. (ed.). New York; Academic Press, Inc. (1973).

The oxidation of irradiated polymers (with emphasis being placed on polyethylene) is reviewed under the following section headings: historical introduction, experimental methods of oxidation studies, oxidation kinetics and G values, oxidation mechanisms, and polymers other than polyethylene. (35 references) (JGB)

186 EFFECT OF RADIATION ON THE MECHANICAL PROPERTIES OF POLYMERS. Lyons, B. J. (Raychem Corp., Menlo Park, CA). pp 281-306 of Radiation Chemistry of Macromolecules. Vol. II. Dole, M. (ed.). New York; Academic Press, Inc. (1973).

A review is presented on the effect of radiation on the mechanical properties of polymers under the following section headings: formation of network structure, including discussions on elastic modulus, effect of crystallinity and diluent, effect of fillers, and ultimate properties; effect of radiation on properties of polymers above the melting point, including early work, morphological model for semicrystalline polymers, radiation effects in polyethylenes of various kinds, and effect of fillers; effects of radiation on properties of polymers below the melting point, including quasi-static mechanical properties, long-term, time-dependent properties, and dynamic mechanical properties; and summary. (49 references) (JGB)

187 SINGLE CRYSTALS. Salovey, R. (Hooker Research Center, Niagara Falls, NY). pp 307-312 of Radiation Chemistry of Macromolecules. Vol. II. Dole, M. (ed.). New York; Academic Press, Inc. (1973).

Research on the radiation chemistry of polyethylene single crystals is reviewed with emphasis placed on the role of cross-linking and trapped radicals. Paraffins are also discussed briefly. (31 references) (JGB)

188 RADIATION EFFECTS IN DRAWN POLYMERS. Dole, M. (Baylor Univ., Waco, TX). pp 313-319 of Radiation Chemistry of Macromolecules. Vol. II. Dole, M. (ed.). New York; Academic Press, Inc. (1973).

Research on radiation effects on drawn polymers is reviewed briefly. Radiation effects on polyamide fiber structure and properties of other polymer fibers are discussed. (JGB)

189 RADIATION CHEMISTRY OF NUCLEIC ACIDS, PROTEINS, AND POLYSACCHARIDES. Myers, L. S. Jr. (Univ. of California, Los Angeles). pp 323-374 of Radiation Chemistry of Macromolecules. Vol. II. Dole, M. (ed.). New York; Academic Press, Inc. (1973).

Research directed toward determining the mechanisms by which radiation brings about changes in nucleic acids, proteins, and polysaccharides is discussed. Major emphasis is on the solid state, with discussion of aqueous solutions limited to recent advances in the formation, structure, and properties of intermediate radical species. Constituents of the polymers are considered in some detail. (171 references) (JGB)

190 ADSORPTION CHEMILUMINESCENCE ON A γ-IRRADIATED ALUMINOSILICATE CATALYST. Erchenkov, V. V.; Plyushch, A. L.; Panchenkov, G. M. (Inst. of the Petrochemical and Gas Industry, Moscow). Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 9, 1368-1369(Sep 1972).

Translated from Zh. Fiz. Khim.; 46: No. 9, 2394(Sep 1972).

The chemiluminescence occurring when γ-irradiated aluminosilicate is exposed to gases was investigated. The emission intensity increases greatly when aluminosilicate containing manganese ions is exposed to hydrogen. (auth)

191 THIN-LAYER CHROMATOGRAPHY OF NUCLEOSIDES. Cadet, J.; Teoule, R. (CEN, Grenoble, France). J. Chromatogr.; 76: No. 2, 407-415(28 Feb 1973). (In French).

A new chromatographic bidimensional system that may be used for the separation of nucleosides and derivatives is described. Silica Gel MN-S-HR/UV_{254} (Macherey-Nagel & Cy.) or Cellulose F (Merck) were utilized with the following solvents: (1) the lower layer of chloroform-methanol-water (4:2:1) with an additional 5% of methanol and (2) ethyl acetate-isopropanol-water (75:16:9). A good separation of the radioproducts resulting from the action of γ-rays on thymidine was obtained. Correlations between structures and R_F values were established. (auth)

192 RADIATION CHEMICAL STUDIES OF THE OXIDATION AND REDUCTION OF NITROFURANS. Oxidative Denitration by OH Radicals. Greenstock, C. L. (Whiteshell Nuclear Research Establishment, Pinawa, Manitoba); Dunlop, I.; Neta, P. J. Phys. Chem.; 77: No. 9, 1187-1190(26 Apr 1973).

Nanosecond pulse radiolysis was used to determine the bimolecular rate constants for the reactions of OH and e^-_{aq} with simple nitrofuran derivatives. The transient optical absorption spectra of the radicals produced by these reactions were characterized. Positive identification of the radicals was achieved from the electron spin resonance spectra recorded with in situ irradiated solutions. The reactions of OH radicals with simple nitrofurans take place with very high rate constants, $\sim 5 \times 10^9$ M^{-1} sec^{-1}, and involve OH addition mainly to the 5 position. Addition of OH to this carbon which bears the nitro group is followed by rapid elimination of nitrous acid. Nitro anion radicals are formed by reaction of e^-_{aq} with the nitrofurans or by electron transfer from α-hydroxyisopropyl radicals. The rate constants for these reactions with 5-nitro-2-furoic acid are respectively 2.2×10^{10} and 1.5×10^9 M^{-1} sec^{-1}. The nitrofuran anion radicals protonate on the nitro group with $pK_a \simeq 1$. In the case of the radical from 5-nitro-2-furoic acid the pK_a values for the nitro and the carboxyl groups were found to be 1.22 and 3.77, respectively. (auth)

193 ELECTRON SCAVENGING AND PRODUCT FORMATION IN THE γ-RADIOLYSIS OF NITROUS OXIDE–LIQUID XENON SOLUTIONS. Rzad, S. J.; Bakale, G. (Carnegie-Mellon Univ., Pittsburgh). J. Phys. Chem.; 77: No. 9, 1176-1182(26 Apr 1973).

γ-Irradiation of solutions of nitrous oxide in liquid xenon at 164°K results in the formation of nitrogen and oxygen, the latter being ~10% of the former. At low [N_2O] both products increase with increasing N_2O concentration then level off between 10^{-2} and 10^{-1} M nitrous oxide ($G(N_2) \sim 8$) and increase again above 10^{-1} M N_2O where they become dependent on the square of the nitrous oxide concentration. The addition of sulfur hexafluoride to the system completely inhibits the formation of both products indicating that the electron is the primary precursor of both species. For a given nitrous oxide concentration the yields of nitrogen increase with decreasing dose rate indicating that the electrons are homogeneously distributed in liquid xenon. Carbon dioxide decreases the yield of nitrogen to a constant value of $G(N_2) = 4.3$ which is found to correspond to the yield of electrons produced by γ-irradiation of liquid xenon (i.e., W = 23.3). The following mechanism is found to be consistent with all of the data: $Xe \rightarrow e^- + Xe^+$; $e^- + N_2O \rightarrow N_2O^-(k_9')$; $N_2O^- + N_2O \rightarrow N_2 + (N_2O)O^-$ (k_{10}); $N_2O^- + CO_2 \rightarrow N_2 + CO_3^-$ (k_9''); $(N_2O)O^- + Xe^+ \rightarrow 2NO + Xe$ (k_{11}); $(N_2O)O^- + N_2O \rightarrow (N_2O)_2O^-$ (k_{12}); $(N_2O)_2O^- + Xe^+ \rightarrow N_2 + 2NO + O + Xe$ (k_{13}); $(N_2O)_2O^- + 2N_2O \rightarrow (N_2O)_3O^- + N_2O$ (k_{14}); $(N_2O)_3O^- + Xe^+ \rightarrow 2N_2 + 2NO + O_2 + Xe$ (k_{15}). From such treatment of the data k_{10} is estimated to be diffusion controlled and of the order $\sim 10^{10}$ M^{-1} sec^{-1}, $k_{11} \simeq k_{13} \sim 1.6 \times 10^{11}$ M^{-1} sec^{-1}, $k_{12} \simeq 8.3 \times 10^4$ M^{-1} sec^{-1}, $k_{14} \simeq 4.7 \times 10^9$ M^{-2} sec^{-1}, and $k_9'/k_{10} = 2.5$. (auth)

194 PULSE RADIOLYTIC INVESTIGATIONS OF THE CATALYZED DISPROPORTIONATION OF PEROXY RADICALS. Aqueous Cupric Ions. Rabani, J. (Hebrew Univ., Jerusalem); Klug-Roth, D.; Lilie, J. J. Phys. Chem.; 77: No. 9, 1169-1175 (26 Apr 1973).

The catalytic effect of Cu^{2+} in enhancing the dismutation of the peroxy radicals HO_2 and O_2^- was investigated. Cu^{2+} ions react with O_2^- ($k = 8 \times 10^9$ M^{-1} sec^{-1}) and with HO_2 radicals ($k \cong 1 \times 10^8$ M^{-1} sec^{-1}). The catalytic effect involves alternate reduction and oxidation of the copper. Cu^+ reacts with O_2^- with a rate constant of $\sim 10^{10}$. HO_2 oxidizes Cu^+, $k > 10^9$ M^{-1} sec^{-1}. The uv absorption spectrum of Cu^+ was measured in formate and in methanol solutions. (auth)

195 STUDY OF METHYL METHACRYLATE IN γ-IRRADIATED ORGANIC GLASSES AT 77°K. Gilbro, T.; Yamaoka, H.; Okamura, S. (Kyoto Univ., Osaka). J. Phys. Chem.; 77: No. 9, 1163-1169(26 Apr 1973).

After γ-irradiation at 77°K in the dark organic glasses of 2-methyltetrahydrofuran and 3-methylpentane containing methyl methacrylate give rise to ESR spectra consisting of three lines with a coupling constant of 11.0 ± 0.2 G, which overlaps the spectra from the pure glasses. The paramagnetic species formed is probably the radical anion of methyl methacrylate as supported by simple MO calculations. Methyl methacrylate in small concentration (0.05 mol %) scavenges the trapped electrons in the two glassy systems. The radical anion is bleached by visible light in the 2-methyltetrahydrofuran glass and methyl radicals derived from the methoxy group are produced. The methyl radicals so formed abstract hydrogen atoms from 2-methyltetrahydrofuran. In the 3-methylpentane glass the radical anion is bleached by ir light and no methyl radicals are observed. The mechanisms of radical anion formation upon γ-irradiation and decay following photobleaching in the two glassy systems are discussed. (auth)

196 REACTION OF OH AND O⁻ RADICALS WITH AROMATIC CARBOXYLATE ANIONS IN AQUEOUS SOLUTION. Simic, M.; Hoffman, M. Z.; Ebert, M. (Univ. of Texas, Austin). Contract AT(40-1)-3408. J. Phys. Chem.; 77: No. 9, 1117-1120 (26 Apr 1973).

The reactivity of OH (pK_a = 11.9) and O^- radicals with aromatic carboxylate anions in irradiated alkaline N_2O-saturated aqueous solution was studied using the pulse radiolysis technique. The compounds studied were the carboxylic acid derivatives of benzene, naphthalene, anthracene, and diphenyl which react with OH and O^- radicals by means of radical addition to the aromatic ring. The transient optical absorption spectrum of the OH adduct to a specific compound is identical with the spectrum obtained from O^- addition to the same compound indicating that the hydroxy group on the resultant-radical is not ionized even at pH 14. From the kinetics of the formation of the transient absorption at pH 9 and 14, the rate constants for the reaction of OH and O^- radicals with the aromatic solutes were determined. The OH radical reacts at nearly diffusion-controlled rates ($k(OH) = 6-8 \times 10^9\ M^{-1}\ sec^{-1}$) with the rate constant virtually independent of the nature of the substrate. The O^- radical reacts much more slowly with values of $k(O^-)$ dependent upon the charge on the substrate, the number of individual aromatic rings available, and the degree of aromaticity. The O^- radical is less electrophilic than is the OH radical and shows an unfavorable interaction with the π-electron system of the aromatic nucleus. (auth)

197 ELECTRON SPIN RESONANCE STUDY OF THE RADICALS PRODUCED BY THE γ IRRADIATION OF XANTHENE. Orlandi, G. (Laboratorio di Fotochimica e Radiazioni Alta Energia, Bologna); Poggi, G.; Barigelletti, F.; Breccia, A. J. Phys. Chem.; 77: No. 9, 1102-1104(26 Apr 1973).

Xanthene powders were γ-irradiated at 77°K and the radical species formed were investigated by ESR technique. The spectra obtained are attributed to the overlapping of a singlet and a triplet. The triplet spectrum disappears upon heating to 105°K. On the basis of theoretical spin density calculations the triplet is attributed to xanthene radical ions while the singlet is tentatively assigned to xanthyl radical. (auth)

198 RADIATION-INDUCED POLYMERIZATION OF ETHYLENE. Takehisa, Masaaki (Japan Atomic Energy Research Inst., Takasaki). Proc. Jap. Conf. Radioisotop.; No. 10, 334-336(Apr 1972).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

A summary of a pilot scale experiment on the radioinduced polymerization of ethylene, carried out at Takasaki Radiation Chemistry Research Establishment, Japan Atomic Energy Research Institute, is given. The process and a pilot plant, results of pilot plant operation, physical properties and structure of polymers, cost estimation, and future aspect and fallouts are described. The polymer yield increased with the increasing residence time of reaction phase, and leveled off after 1.5 hr. The mean residence time was proportional to the molecular weight of the polymer. The activation energy of polymerization had a minus value at temperatures lower than 80°C. The dose rate exponent of the yield was about 0.6, indicating that the polymerization included both first order and second order terminations. The rate of the second order termination reaction increased with agitation. Polyethylene produced by this process (Takathene) was obtained in the form of a fine powder, the mean diameter of which was between 8 and 20 microns. The specific surface area of the Takathene was 30 to 100 m^2/g, while that of the commercially available powdery polyethylene was 1 m^2/g. The specific pore volume of the Takathene powder was very large, and the distribution of the pore radius had a peak at 60 to 80 Å. Therefore, the Takathene is expected to show excellent reactivity in chemical reactions and grafting. The total cost of production is 183.3 Yen/kg including direct labor, maintenance, and insurance. (Japan)

199 PULSE-RADIOLYSIS OF AQUEOUS $KBrO_4$ SOLUTIONS. Olsen, K. J. (Univ. of Aarhus, Denmark); Sehested, K.; Appelman, E. H. Chem. Phys. Lett.; 19: No. 2, 213-214(15 Mar 1973).

Pulse-radiolysis of aqueous $KBrO_4$ solutions show that BrO_4^- reacts with e_{aq}^- by the reaction $BrO_4^- + e_{aq}^- \rightarrow BrO_3^- + O^-$, $k_{e_{aq}^- + BrO_4^-} = (7.0 \pm 0.7) \times 10^9\ M^{-1}\ sec^{-1}$. The reactions between BrO_4^- and H, OH and O^- are slow. The rate constants for these reactions are less than $10^7\ M^{-1}\ sec^{-1}$. (auth)

200 RADIATION-INDUCED CROSSLINKING IN POLYISOPRENES WITH HIGH CONTENT OF 1, 2- AND 3, 4-UNITS. Heusinger, H.; Katzer, H. (Technische Univ., Munich). Proc. Jap. Conf. Radioisotop.; No. 10, 324-333(Apr 1972).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

An investigation was made on the radiolytic behavior of polyisoprenes with large contents of 1,2- and 3,4-isomeric units. In contrast to 1,4-polyisoprenes, these units contain a double bond in the side chain. Crosslinking of the chains gave rise to an increase in molecular weight, and led finally to an insoluble gel. The crosslinking was studied below and above the gel point. Gel formation due to the crosslinking by chain reaction started, if a part of the molecules were involved in two independent chain reactions. G-values for the formation of a chain-starting species G(S) and inhibitor factor i were deduced from the comparison of experimental log s versus r plot with curves calculated on the basis of theory. The initial G-values for double bond destruction were deduced by extrapolating the almost linear part of the plot to zero dose. The G-value for double bond destruction obtained by this method was about 130 for the 1,2- as well as for the 3,4-units. It was found that the G-values for the chain starting species varied to some extent by changing the dose rate by a factor of 2, but the inhibitor factor i was almost constant. The influence of several additives, which were known to be effective radical scavengers, was also investigated for anthracene, hydroquinone, and air. (Japan)

201 VISCOSITY EFFECTS IN RADIATION-INDUCED GRAFT POLYMERIZATION. Silverman, J.; Block, I. (Univ. of Maryland, College Park). Proc. Jap. Conf. Radioisotop.; No. 10, 316-323(Apr 1972).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

The radioinduced grafting of styrene to polyethylene and of butadiene to poly(vinyl chloride) and to chlorinated polyethylene is examined under conditions of high matrix viscosity. The high viscosity conditions are achieved by three methods: brief exposure of the polymer to a gaseous monomer prior to irradiation; steady exposure to dilute solutions of the monomer in methanol during irradiation; and chemical modification to increase the elastic modulus and glass transition temperature of the polymer prior to its simultaneous exposure to monomer and radiation. With the chlorinated polymers, several viscosity-modifying effects were observed to occur spontaneously during the grafting reaction. These viscosity-related effects lead to principles of radioinduced graft copolymerization which appear to be useful in industrial applications and in the ESR study of grafted propagating radicals. (auth)

202 RADIATION-INDUCED POLYMERIZATION OF TRIOXANE IN THE SOLID STATE. Ito, Akihiko (Japan Atomic Energy Research Inst., Takasaki). Proc. Jap. Conf. Radioisotop.; No. 10, 313-315(Apr 1972).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

Studies made in JAERI's Takasaki Radiation Chemistry Research Establishment on the radioinduced polymerization of trioxane are described. In this procedure, postpolymerization is used with electron beam irradiation. In the polymerization of trioxane, presence of water less than 0.03 wt. % as an impurity does not greatly affect the process. One feature in the postpolymerization of trioxane is that allowable impurity concentration can be relatively high. In the pilot-scale experiment with drum and cylindrical reactors, it was found that a preirradiation dose of 1.0×10^6 rad and polymerization temperature of 55°C are most favorable to obtain polyoxymethylene with excellent properties. One outstanding advantage of the solid-state polymerization is the low heat of the process. A semi-commercial plant of 1,000 tons/year capacity was preliminarily designed and is illustrated. Problems of its modification to obtain high thermal stability, and also of copolymerization for the same purpose, are also described. (Mori, K.)

203 MOLECULAR MOTION AND POLYMERIZATION KINETICS OF METHYL METHACRYLATE ADSORBED ON ZEOLITE. Le Bail, H.; Zemb, T.; Chachaty, C. (CEN de Saclay, Gif-sur-Yvette, France). Compt. Rend., Ser. C; 276: No. 2, 121-124(8 Jan 1973). (In French).

The radicals formed during the γ irradiation at 77°K of methyl methacrylate adsorbed on zeolite 13 X were studied using ESR, the post-polymerization kinetics being determined by wide band NMR techniques. The labeling of the molecules with a nitroxide group enabled the correlation and reorientation times to be determined for the monomer as a function of temperature. (FR)

204 EFFECTS OF IN-PILE RADIATION ON REACTIVITY OF SOLIDS. Naito, K. (Nagoya Univ., Japan). Proc. Jap. Conf. Radioisotop.; No. 10, 438-440(Apr 1972). (In Japanese).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

As the object of radiation chemistry in the past, various reactions of organic materials with γ rays were stressed, but hereafter, effects of irradiation with heavy ionized particles and neutrons will be important. The effects of in-core radiation on inorganic solids are outlined from the viewpoint of radiation damage. In nuclear reactors, there are various radiations such as neutrons, γ rays, fission fragments, and β rays or α rays. The neutrons and γ rays are distributed widely in the reactors, and in thermal neutron reactors, the energy of the neutrons is the same as that of γ rays, i.e., 2 MeV. The irradiation effects involve ionization, excitation, nuclear transformation, and recoil effect. As the effects of ionization and excitation, one of the most interesting problems is the linear energy transfer effect on the G-value of the neutrons and fission fragments in gas and liquid. As for the nuclear transformation effect, (n,γ) reactions with low-energy neutrons, and neutron-alpha (or proton) reactions with fast neutrons are observed. By the nuclear transformation and displacement effects, many lattice defects are introduced into solids. It is observed that speed and displacement point in the phase transformation of solids are changed by irradiation. The lattice defects being produced by the irradiation of metal change potential of mono-electrode, and the lattice defects stimulate diffusion in solids, and increase speed of reaction. The effect by the fission fragments, which is also called the spike effect, can not yet be described clearly. (Japan)

205 DEPENDENCE OF EXCESS CONDUCTANCE OF LIQUID ORGANIC SYSTEMS ON THE COMBINED INTENSITIES OF X RAYS AND ILLUMINATION. Trofimova, T. N.; Kopylov, Yu. A.; Svergunenko, L. A.; Koval, V. M. (Dnepropetrovsk Agricultural Inst., USSR). Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 9, 1268-1269(Sep 1972).

Translated from Zh. Fiz. Khim.; 46: No. 9, 2219-2221(Sep 1972).

Relations are obtained between the excess conductance of liquid organic systems and the intensities of x-rays and light acting together. The system investigated was a solution of iodobenzene in diethyl ether. The combined effect of x-rays and light on the conductivity is not additive at any intensities. At certain intensity ratios the x-ray conductivity is partly quenched by the action of light, while the photoconductance is quenched by the x-rays. Maximum quenching is observed at a definite intensity ratio, but also depends on the spectral composition of the light. (auth)

206 CONCENTRATION VARIATION OF THE LIGHT- AND X-RAY-INDUCED CONDUCTIVITY IN LIQUID ORGANIC PHOTOCONDUCTORS. Koval, V. M.; Svergunenko, L. A.; Kopylov, Yu. A.; Trofimova, T. N. (Dnepropetrovsk Agricultural Inst., USSR). Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 9, 1311-1313(Sep 1972).

Translated from Zh. Fiz. Khim.; 46: No. 9, 2298-2301(Sep 1972).

The concentration variation of the light- and x-ray-induced conductivity of liquid organic systems is reported. The dependence of the conductivity of the iodobenzene-ethyl ether system was investigated at different iodobenzene concentrations in the range between 0.006 and 1.00 (volume fractions) with the system acted upon by light, x-rays, and both simultaneously. A study was made of the conduction kinetics for different radiation intensities. The concentrations of the components at which the effects of the conductivity induced by radiation reach maximum values were found. The concentrations at which the quenching by illumination of the conductivity due to irradiation by x-rays is a maximum were established. The experimental results were explained in terms of predissociation states and light-induced recombination of current carriers. (auth)

207 BEHAVIOR OF ELECTRICAL CHARGES IN IRRADIATED ORGANICS. Charlesby, A. (Royal Military Coll. of Science, Shrivenham, Eng.). Proc. Jap. Conf. Radioisotop.; No. 10, 304-312(Apr 1972).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

Results obtained from radiation-induced conductivity and thermoluminescence in simple organic compounds are compared for the study of behavior of electric charges in material. In the study of the conductivity induced in organic materials during and following irradiation, the nature of current carriers, their number, mean lifetime, and mobility are taken into consideration. The expression for the mobility, μ, was corrected with a correction factor on the basis of the idea of carrier traps to conform calculated value to measured value. The mobility of the carriers in n-hexane was measured at room temperature, and the result led to the value of μ in the neighborhood of 10^{-3} $cm^2/V \cdot sec$. More detailed studies are explained. When an organic specimen is irradiated at low temperature and subsequently warmed up to room temperature, light is emitted. From such an experiment, two types of information can be obtained: (a) the temperature at which electrons are released from the matrix and (b) the nature of luminescence centers. One of the thermoluminescent glow peaks is associated with the presence of oxygen molecules in the matrix. Many of the peaks seen in irradiated hydrocarbons are associated with the matrix itself and not with impurities. Sudden increase in the light output at 77°K from a 40-micron irradiated polyethylene film was observed when 7000 volts was applied across it. The electron spin resonance pattern of trapped electrons, consisting of singlets, could be observed in an alkane glass following irradiation at 77°K. A proposal concerning the nature of the electron traps is presented. (Japan)

208 FISSION-NEUTRON PULSE RADIOLYSIS. Tabata, Y. (Tokyo Univ.); Danno, A. Proc. Jap. Conf. Radioisotop.; No. 10, 427-428(Apr 1972). (In Japanese).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

As radiation sources for pulse radiolysis, pulsed electrons from the LINAC or an electron beam due to the instantaneous discharge in a Van de Graaff generator or betatron have been employed to date. Here, the use of neutrons for irradiation is described. Ionization in matter, based on fast neutrons, can be caused by recoil nuclides accelerated in consequence of neutron elastic scattering. Action due to thermal neutrons can be caused by the γ ray emitted as the result of a (n,γ) reaction with high-molecular weight compounds. As pulsed-neutron sources, two methods are practicable at present. One is fast pulse reactors of the repetition type realized by the pulsed operation of nuclear reactors, and the other is to utilize the neutrons generated from the heavy metals irradiated with pulsed electrons from the LINAC. Promising fields for the chemical utilization of pulsed neutrons are ion beam radiochemistry and radioactivation analysis with the pulsed neutrons. (Japan)

209 APPLICATION OF THE METHOD OF PULSE RADIOLYSIS TO POLYMERIC SYSTEMS. Schnabel, W. (Hahn-Meitner Institut fuer Kernforschung, Berlin). Proc. Jap. Conf. Radioisotop.; No. 10, 393-400(Apr 1972).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

Studies were made on the dependence of rate of the rapid bimolecular reaction involving macromolecules and macroradicals on chain length. In general, the following types of reaction were investigated: (1) the reaction X + P of highly reactive particles X with the intact macromolecules, P; (2) the reaction P + S of highly reactive scavengers S with the macroradicals, P; and (3) the chemical interaction of the macroradicals P + P. The polymers and oligomers used are diethylene glycol, triethylene glycol, poly(ethylene oxide), polyvinylpyrrolidone, cellobiose, maltose, and Na polyacrylate. Aqueous solutions of the solutes were irradiated at room temperature either with μsec-pulses of 1.5-MeV electrons from a Van de Graaff generator, or with the 50-nsec pulses of 14-MeV electrons from a linear accelerator. The rate constant of the reaction of X + P type was given by $-d[X]/dt = K_M[X][P]_M = K_m[X][P]_m$, where $[P]_M$ and $[P]_m$ are polymer concentration in mole/liter and in base mole/liter, respectively, and K_M and K_m are the rate constant in liter/mole · sec and liter/base mole · sec, respectively. Discussion was developed on the results of measurement of the rate constant. The rate constant of the other types of reaction was also given and used for the discussion. (Japan)

210 TRANSIENT SPECIES OF ALKYL KETONE RADIOLYSIS. Revina, A. A. (Inst. of Electrochemistry, Moscow). Proc. Jap. Conf. Radioisotop.; No. 10, 386-392(Apr 1972).

From Tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

With the aim to understand the effect of an alkyl radical and the position of a carbonyl group on the mechanism of radiation reactions, symmetrical and asymmetrical ketones were studied, namely CH_3COR and RCOR, where R is C_nH_{2n+1} and n = 1-6. Cyclohexyl

methyl ketone is a particular system because of the glassy state at 77°K. Particular attention was paid to the removal of oxygen which is known as an efficient electron trap. In the liquid phase, 4-MeV electron pulse irradiation with 2.2-μs pulses was used, and conventional spectrophotometric registration was made. The dose per pulse was about 2 to 4×10^{17} eV/g. ESR, low-temperature spectrophotometric, and thermoluminescence studies were carried out on γ-irradiated samples at 77°K. The dose rate was 1.8×10^{16} eV/g·s as determined by Fricke dosimetry. In the pulse irradiation of thoroughly evacuated samples, a transient absorption band with resolved structure and characteristic maximum at 330 to 340 nm appeared in all the ketones investigated. Except acetone, all the ketones showed similar absorption bands at λ_{max} of about 340 to 330 nm. The decay characteristics at the λ_{max} were of a first order process. A characteristic e^-_{tr}-spectrum was not detected in the symmetrical ketones. The transient absorption band maximum at 900 nm was observed by pulse radiolysis. The absorption disappeared in the presence of anthracene, and the absorption band at λ_{max} 730 nm appeared due to be (anthracene)$^-$. In the presence of oxygen, no absorption was observed. (Japan)

211 *RECENT ADVANCES IN RADIATION-INDUCED POLYMERIZATION IN JAPAN.* Danno, A.; Ito, A. (Japan Atomic Energy Research Inst., Takasaki). Proc. Jap. Conf. Radioisotop.; No. 10, 526-537(Apr 1972).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

A summary is presented on the studies carried out in 1970. The studies were concentrated on the investigation of solid state polymerization and polymerization of nomomers containing fluorine. The studies are classified into those related with radiation-induced polymerization in the gas and liquid phases, radiation-induced polymerization in the solid state, radiation-induced polymerization and copolymerization of the fluorine-containing monomers, radiation-induced graft copolymerization, and radiation-induced polymerization under specific conditions. The Takasaki Radiation Chemistry Research Establishment, Japan Atomic Energy Research Institute, has been very active in the development of ethylene polymerization in the gas–liquid phases. A continuous process was established, and a ^{60}Co source of 14 kCi was installed to realize a large production of polyethylene powder. In the solid state polymerization, the effects of lattice defects, monomer mobility, and impurities were studied to elucidate the polymerization mechanism. The radiation-induced polymerization of the fluorine-containing monomers was especially important in that the resulting polymers showed various excellent properties. The graft-copolymerization of butadiene onto poly(vinyl chloride) also gave various interesting products. (Japan)

212 POTENTIAL RESEARCH TRENDS IN RADIATION SCIENCE. Charlesby, A. (Royal Military Coll. of Science, Shrivenham, Eng.). Proc. Jap. Conf. Radioisotop.; No. 10, 76-84 (Apr 1972).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

Although the early history of radiation chemistry was largely confined to the effects produced by relatively low-intensity x-ray and by alpha radiation because of the lack of radioactive sources of adequate strength, at present, there are a number of radiation sources, strong and weak, because of the development of nuclear fission studies and reactors. Cost of irradiation is now no longer a serious problem; irradiation should have a more important position in the supply of radicals and ions for initiating chemical reactions. One example is electrons, which have attracted considerable interest in recent years. In the presence of thymidine, most electrons react and give thymine anions, $e + th \rightarrow th^-$. This reaction is observed by changed ESR and optical spectra. This scavenging of the electrons by thymidine greatly reduces the peak height due to the electrons trapped in the matrix. Exposure to white light frees the remaining trapped electrons, which then react and give further thymidine anions. On warming to 123°K, H atoms trapped in an acid glass disappear by mutual combination, $H + H \rightarrow H_2$. Further warming to 160°K or ultraviolet bleaching leads to further reaction, $th^- + H^+ \rightarrow thH$. By the investigation of these processes, it is possible to break down the overall process into a series of steps in which the electrons play a very important role. Cross-linking of polyethylene is one of the most widespread applications of high-energy irradiation. A wide variety of knowledge is collected through this application on the mechanism of various chemical reactions. (Japan)

213 PULSE RADIOLYSIS STUDY OF ORGANIC CATIONS. Arai, S.; Kira, A.; Imamura, M. (Inst. of Physical and Chemical Research, Wako, Japan). Proc. Jap. Conf. Radioisotop.; No. 10, 383-385(Apr 1972). (In Japanese).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

Many studies, mainly centering around pulse radiolysis, have been presented regarding ionization and chemical behavior of molecules occurring as a result of the interaction of radiation with matter. However, research has not progressed very far on the chemical behavior of positive ions generated at the same time. A powerful method for the purpose is to capture the positive ions of solvent molecules by adding aromatic hydrocarbons and to examine the positive ions of solute generated. Alcohol, acetone, dimethylformamide, and benzonitrile solutions were studied as to their positive and negative ion generation as organic solvents. When the benzonitrile solution of trans-stilbene saturated with air is irradiated with an electron beam, the positive ions of the solute are generated. If pyrene is used as a solute, however, the absorption spectra immediately after pulse vary with pyrene concentration. (Japan)

214 RADIATION CHEMICAL STUDIES WITH NITROFURAZONE AS RELATED TO ITS MECHANISM OF RADIOSENSITIZATION. Chapman, J. D.; Greenstock, C. L.; Reuvers, A. P.; McDonald, E.; Dunlop, I. (Atomic Energy of Canada Ltd., Pinawa, Manitoba). Radiat. Res.; 53: No. 2, 190-203(Feb 1973).

The reaction rate constants for e^-_{aq} and OH with nitrofurazone were experimentally measured as 2.8×10^{10} M^{-1} s^{-1} and 10.6×10^9 M^{-1} s^{-1} respectively by pulsed electron radiolysis techniques. Electron transfer from various substrate radicals to nitrofurazone was observed and rate constants determined. From steady-state yields of "destroyed nitrofurazone," G values were determined for the destruction of this sensitizer by separate radical species. Radioinduced binding of nitrofurazone to DNA was measured and the importance of this reaction is discussed in relation to various radiosensitizing mechanisms. Of the various substrate radicals tested, those generated by OH reactions with pyrimidines were found to react most efficiently with nitrofurazone. These data suggest that an important part of the radiosensitizing mechanism of nitrofurazone results from irreversible binding of the sensitizer to radicals in DNA. In this respect nitrofurazone may radiosensitize hypoxic cells by a radiation chemical mechanism similar to that of molecular oxygen and other electron-affinic compounds. (auth)

215 *EFFECTS OF γ IRRADIATION ON SULPHONAMIDES.* Phillips, G. O.; Power, D. M.; Sewart, M. C. G. (Univ. of Salford, Eng.). Radiat. Res.; 53: No. 2, 204-215(Feb 1973).

The effects of γ radiation on five sulfonamides were studied in aqueous solution and in the solid state. On irradiation in solution sulphathiazole yields sulfanilic acid (G = 0.6), sulfasuccidine yields sulfathiazole (G = 0.7), and thalamyd gives sulfacetamide (G = 1.4) and phthalic acid (G ~ 1.0). Each of these transformations are initiated by reaction with the hydrated electron. The hydroxyl radical initiates degradation also and forms an adduct by addition to the aromatic ring, which eventually yields phenol products. The rates of reaction of the sulfonamides and certain related compounds with the hydrated electron and the hydroxyl radical and transient products of radiolysis were determined using pulse radiolysis and steady state competition methods. G(–sulfonamide) values in aqueous solution vary from 3.5 to 5.1, and in the solid state from 0.15 to 0.6. The implications of the results in the radiation sterilization of sulfonamide formulations are discussed. (auth)

Radiochemistry and Nuclear Chemistry

Refer also to abstracts 1310 and 1537.

216 (HEDL-TME-72-61) PLUTONIUM FUELS LABORATORY DATA ACQUISITION SYSTEM PROGRAMMING GUIDE. Markillie, W. R.; Crow, V. L. (Hanford Engineering Development Lab., Richland, Wash.). Jan 1973. Contract AT(45-1)-2170, 41p. AT $4.00.

A programming guide to the Hanford 308 Building Foreground/Background Operating System is presented. Background assembly language programming, foreground programming, and monitor services are elaborated. (WHK)

Hot-Atom Chemistry

217 TRANSPORT OF RECOIL ATOMS IN A N_2 AND Cl_2/N_2 GAS STREAM. Boegl, W.; Baechmann, K.; Buettner, K.; Moheit, N. (Technische Univ., Darmstadt, Ger.). Inorg. Nucl. Chem. Lett.; 9: No. 4, 405-413(Apr 1973). (In German).

A study has been made of the transport in N_2 and N_2/Cl_2 streams of Te, Sb, and Sn recoil atoms from the spontaneous fission of ^{252}Cf, taking the 131 isobaric chain as example. It is concluded

that ^{131}Te is transported in a stream of pure N_2 although only a small proportion of it stems directly from spontaneous fission, the greater proportion being formed from ^{131}Sn and ^{131}Sb deposited on the wall and then transported. The addition of Cl_2 to the N_2 utream leads to ^{131}Sn, ^{131}Sb and ^{131}Te being transported. Investigation showed that the study of recoil product transport from a ^{252}Cf source is complicated by the participation of precursor nuclides. Conclusions on the behavior of recoil atoms cannot be drawn from measurements on a single nuclide such as ^{131}Te. (auth)

218 *EFFECT OF HELIUM MODERATOR IN STUDIES OF* HOT HYDROGEN REACTIONS WITH HYDROCARBONS. Malcolme Lawes, D. J. (Kent Univ., Canterbury, Eng.); Urch, D. S. J. Chem. Soc., Chem. Commun.; No. 4, 107-108(21 Feb 1973).

The relative H-abstraction yield obtained by the recoil tritium reaction with ethane is found to rise in the presence of helium, suggesting that the collisional dissociation of excited HT plays a major role in determining the final product ratio. (auth)

219 COLLISION DENSITY IN RECOIL HOT ATOM SYSTEMS. Effect of Reactive Events. Malerich, C. J.; Spicer, L. D. (Univ. of Utah, Salt Lake City). Chem. Phys. Lett.; 18: No. 3, 405-407 (1 Feb 1973).

Characteristics of the collisional distribution function for reactive hot atoms in nuclear recoil systems are examined and illustrated for the T + H_2 system both unmoderated and moderated with argon. Reaction induced extrema are evident in the collision density of the unmoderated case. For this system depletion of hot atoms from the collisional distribution function due to reactive events is reflected significantly in the product yields even at high moderation. (auth)

220 REAPPRAISAL OF AN INCONSISTENCY IN RECOIL TRITIUM CHEMISTRY. Malcolme-Lawes, D. J. (Kent Univ., Canterbury, Eng.). J. Chem. Soc., Chem. Commun.; No. 6, 225-226(21 Mar 1973).

A major qualitative inconsistency in the yields of hot products from the reaction of recoil tritium atoms with mixtures of hydrogen and methane is re-examined in the light of recent suggestions that collisional dissociation of excited HT plays a significant role in determining the H-abstraction yield. (auth)

221 HOT ATOMS AND EXCITED STATES. Yoshihara, K. (Tohoku Univ., Sendai). Proc. Jap. Conf. Radioisotop.; No. 10, 434-437(Apr 1972). (In Japanese).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

Recent problems in the common field of hot atom chemistry and radiation chemistry are reviewed with reference to the results of beam experiments. As the example of study of ion–molecule reactions with a double mass spectrometer, the analysis of excitation and breakdown of CH_3NH_2 performed at Tohoku University is given. As the example of study of the mechanism of the ion–molecule reaction with a tandem mass spectrometer, the works by Koshi, et al., about O_2, N_2, CH_4, and CH_3X(X = F, Cl, Br, I) are cited. Wolfgang's studies on the ion–molecule reaction with an EVA chemical accelerator, studies on the reaction between tritium and molecules with an ADAM chemical accelerated $^{14}C^+$ ions and organic compounds are also cited together with many other studies abroad. As the domestic work, the studies by Yoshihara, et al., to investigate the energy dependence of a recoil reaction in solids in energy range below 100 eV are cited. As an example, the recoil energy dependence of the yield of $^{115m}In^{3+}$ ions from the (γ,γ') reaction of indium EDTA complex is shown. (Japan)

Properties of Radioactive Materials

Refer also to abstracts 89, 118, and 145.

222 *(CEA-R-4374) RELATION BETWEEN THE STRUC*TURAL AND ELECTRICAL PROPERTIES OF ANODIC OXIDE FILMS FORMED ON URANIUM AND THE ELECTROCHEMICAL *BEHAVIOR OF URANIUM IN AQUEOUS MEDIA. Jouve, G.* (Commissariat a l'Energie Atomique, Bruyeres-le-Chatel (France). Centre d'Etudes). Feb 1973. 103p. (In French). Dep. NTIS (U. S. Sales Only) $7.25.

Thesis. Submitted to Paris Univ., Orsay, France.

A general study of the electrochemical parameters involved in the oxidation of uranium at different pH values was effected using potentiokinetic and galvanostatic methods, grazing incidence and transmission electron diffraction techniques being used simultaneously to determine the phases formed at the surface of the metal. Interferometric techniques were used to continuously monitor the thickness of the oxide films; in this way the kinetics of the films were determined. A film formed at a pH of 13 was studied using electron microscopy; its electrical properties were determined. This study revealed the following results: in acid and neutral media the polarization curves indicated a reduced anodic current and the existence of a plateau region; this region is believed to be due to a passivation phenomenon; in basic media the successive growth of two oxide films was demonstrated and their phase was identified using electron diffraction techniques. A complementary study of the structure of the film and its electrical properties indicated that the fissuration of the surface film (formed at constant potential) can be attributed to an electrical break down phenomenon. A model is proposed which attempts to account for the mechanisms involved in a double film system. It was thus possible to synthesize the behavior of the metal in basic media with small potentials. The polarization curves obtained are discussed in terms of the results acquired on the properties of the films formed under different electrochemical conditions. (auth)

223 (CEA-R-4380) STUDY OF THE EQUATION OF STATE AND DETERMINATION OF MOLECULAR PARAMETERS OF SOME FLUORINATED GASES. Morizot, P. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Feb 1973. 118p. (In French). Dep. NTIS (U. S. Sales Only) $8.00.

Thesis. Submitted to Paris Univ. (France).

Volumetric and dielectric techniques are used to determine non-ideality and molar polarization of UF_6, MoF_6, WF_6 and ClF_3. Comparisons are made between these dielectric non-ideality parameters and those obtained by MAGNUSON and volumetry method. It is demonstrated that dielectric nonideality parameters are unsettled by an adsorption phenomena on the electrodes. The volumetric second virial coefficients are interpreted with known transport coefficients to determine molecular parameters of the three hexafluorides. Using viscosity data, the existence of a dimerization in the vapor of ClF_3 was demonstrated. Its effect on the observed second virial coefficient was evaluated. (auth)

224 *(CEA-R-4424) PRINCIPAL PHYSICAL PROPERTIES* OF FLUORIDES AND OXYFLUORIDES OF FISSION PRODUCTS. Roux, J. P.; Valladon, M. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Feb 1973. 72p. (In French). Dep. NTIS (U. S. Sales Only) $5.75.

The best known fluorides and oxyfluorides are reviewed for the elements of the fission products (atomic number from 30 to 66). A description is given for each of these compounds including the following properties: preparation, stability, enthalpy and free energy of formation, melting, boiling, sublimation, triple and critical points, equations of vapor pressures above the liquid and solid phases. These properties are listed in order to understand the behavior of these compounds in a fluoride volatility process. On account of the fullness of the subject, only the main references are mentioned. (auth)

225 (IA-1268) RECOVERY OF URANIUM FROM THE *I.M.I. PHOSPHORIC ACID PROCESS. Ketzinel, Z.; Volkman, Y.;* Yakir, D. (Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center). Nov 1972. 22p. Dep. NTIS (U. S. Sales Only) $3.25.

The distribution of uranium in the various stages of the I.M.I. (Israel Mining Industries) solvent extraction process for producing phosphoric acid was found to be highly dependent on the calcium chloride concentration in the aqueous streams. Utilizing this fact, a small aqueous stream with a relatively high amount of uranium can be obtained along the route of the phosphoric acid process. The uranium can easily be recovered from this stream by solvent extraction. Thus the cost of producing uranium as a by-product of phosphoric acid production can be considerably reduced, due to lower solvent losses in the aqueous solutions and smaller equipment. (auth)

226 (JINR-P6-6963) RELATIVE RETENTIONS OF SOME *ALKYLASTATIDES, IODIDES, AND BROMIDES ON DINONYL* PHTHALATE. Kolachkovski, A.; Norseev, Yu. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 17p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The relative retentions of 1-halogenalkanes and 2-halogenalkanes (bromine, iodine and astatine) in which the number of carbon atoms varies from 1 to 5 on dinonyl phthalate was determined. The experiments were performed using a glass gas radiochromatograph at a column temperature of 95°C, 105°C and 115°C. (auth)

227 ELECTRONIC SPECTRA AND MAGNETIC CIRCULAR *DICHROISM OF THE URANYL ION. Brint, P.; McCaffery, A. J.* (Sussex Univ., Brighton, Eng.). Mol. Phys.; 25: No. 2, 311-322 (Feb 1973).

The magnetic circular dichroism (MCD) and absorption spectra of $(Bu_4N)UO_2(NO_3)_3$, where Bu = butyl, have been measured over the range 18,000 to 33,000 cm^{-1} in a rigid polymer matrix at ~10 K. A large number of sharp peaks are observed including structure in the high energy region previously referred to as the "structureless continuum." It is shown that group theory places some rather strict limitations on the electronic states and the possible transitions between them, and it was concluded that the most probable

orbital ordering is $e_{1g} < a_{1g} < a_{2u} < e_{1u}$ and that the low energy bands arise from transitions to the triplet states $^3E_{1g}$ and $^3E_{2g}$. The higher energy band structure is assigned as due to transitions to $^3E_{1u}$. Second order spin-orbit interaction is necessary to account for the unsymmetric splitting of the triplets. Furthermore it is demonstrated that the symmetry $D_{\infty h}$ will not account for the intensity of absorption and MCD of the observed transitions and that the effective molecular symmetry is D_3. (auth)

228 HIGH-TEMPERATURE GAS-CHROMATOGRAPHY OF SOME INORGANIC CHLORIDES. Tohyama, I. (Government Industrial Research Inst., Osaka); Otozai, K. Z. Anal. Chem.; 262: No. 5, 346-348(1972).

An electric conductivity detector was used successfully for the detection of inorganic chlorides in high temperature gas chromatography (450 to 1000°C). The following mixtures can be separated by the carrier gas He (60 ml/min) on a 250 mm Pt-column with the packing constructed of a fused salt and Chromosorb WAW: $BeCl_2/AlCl_3$ at 560°C; $PbCl_2/SnCl_2$ at 780°C; $BiCl_3/SbCl_3$ at 660°C; $BiCl_3/PbCl_2$ at 560°C; $TlCl/FeCl_3$, $TlCl/BeCl_2$, $TlCl/AlCl_3$, $ThCl_4/AlCl_3$ at 640°C; $InCl_3/(AlCl_3 + FeCl_3)$ at 660°C; $ZnCl_2/PbCl_2$ at 780°C; $SnCl_2/(NaCl + KCl)$ at 830°C; and $TlCl/PbCl_2$ at 830°C. (auth)

229 CRYSTAL AND MOLECULAR STRUCTURE OF [bis(N-ETHYLENEDIMETHYLAMINESALICYLALDIMINATO)DIOXOURANIUM(VI)]. Bandoli, G.; Clemente, D. A.; Benetollo, F.; Vidali, M.; Vigato, P. A.; Casellato, U. (Consiglio Nazionale delle Ricerche, Padua). Inorg. Nucl. Chem. Lett.; 9: No. 4, 433-436(Apr 1973).

Work concerning the synthesis and study of uranyl complexes with tetradentate Schiff bases was extended to include those containing tridentate Schiff bases. The potential ability of the ligand obtained from salicylaldehyde and N,N-dimethylethylendiamine to function as a tridentate linking through the oxygen and both the nitrogen atoms should be of some interest. The complex was obtained from the reaction of $UO_2Cl_2 \cdot 3H_2O$ with stoichiometric amounts of the Tl(I) derivative of the Schiff base in EtOH at room temperature. In order to determine the coordination number around the uranyl group, x-ray structure analysis of the complex was undertaken. Some preliminary results are presented. (auth)

230 FREE ENERGY OF FORMATION OF THE URANYL ION AT ELEVATED TEMPERATURES. Rafal'skii, R. P. At. Energ. (USSR); 34: No. 2, 115-116(Feb 1973). (In Russian).

More accurate values were determined for the equilibrium constant for the equation: $2UO_2^{2-} + 2H_2O \rightleftharpoons 2UO_2(s) + 4H^+ + O_2$ at 50° intervals over the range 100 to 300°C. Using these equilibrium constants, the free energy of formation of the uranyl ion was computed: $-G^0_{UO_2}$ at 100°C = 226, at 300°C = 214 kcal/mole. (KSW)

231 APPLICATION OF THE STUDY OF RADIOACTIVE EMANATIONS TO THERMAL ANALYSIS STUDIES IN THE PHYSICAL CHEMISTRY OF SOLIDS. Balek, V. (Karlova Univ., Prague). Analusis; 1: No. 6, 445-451(Nov 1972). (In French).

The application of the study of radioactive emanations to thermal analysis studies (ETA) is discussed. The method is based on the measurement of the escape velocity of radioactive inert gas atoms from a labeled solid sample. The introduction of radioisotopes into the substances studied is described together with the basis of the ETA theory. The usefulness of ETA theory in various disciplines in chemistry (above all those concerned with aging, crystallization of precipitates, polymorphic transitions, and chemical reactions taking place during the heating of solid bodies) is presented. The results of ETA studies are compared with those obtained using other thermoanalytical methods. (France)

232 EQUILIBRIA OF URANIUM CARBIDES IN THE MOLTEN FLUORIDE SOLUTIONS OF UF_3 AND UF_4 CONTAINED IN GRAPHITE AT 850°K. Toth, L. M.; Gilpatrick, L. O. (Oak Ridge National Lab., TN). J. Inorg. Nucl. Chem.; 35: No. 5, 1509-1513(May 1973).

The equilibration of dilute molten fluoride solutions of UF_4 with UC, U_2C_3, and UC_2 at 850°K was investigated to establish that a UC_2 phase, possibly oxygen-stabilized, is the stable carbide phase in contact with dilute UF_3-UF_4 solutions contained in graphite. The carbides were identified by x-ray powder patterns. Lattice parameters for these carbides are included. UF_3 and UF_4 concentrations in solution were measured by near ir-visible adsorption spectrophotometry. Equilibrium quotients, $Q = (UF_3)^4/(UF_4)^3$ were calculated for each of the carbides in contact with the molten fluoride solution based on the reaction: $UC_x + 3UF_4 \rightleftharpoons 4UF_3 + xC$. (auth)

233 STUDY OF URANATE HYDRATES. 1. X-ray Crystallographic Properties of Hydrated Uranates of Bivalent Cations. Sobry, R. (Univ., Liege). J. Inorg. Nucl. Chem.; 35: No. 5, 1515-1524(May 1973). (In French).

The x-ray powder patterns of six synthetic compounds of general formula, $mXO \cdot 2UO_3 \cdot (4-2m)H_2O$ (X = Ca, Sr, Pb, Ba and $O \leq m < 2$) are indexed. The patterns are very similar if one considers the indexation in an orthorhombic pseudohexagonal unit cell of approximate dimensions: $a' = 7.05$ Å, $b' = 4.08$ Å, $c' = 7.32$ Å. The analogy may be easily extended to hydrated uranates (H.U.) of ammonium, and the study of H.U. of bivalent cations is an indirect way to understand the properties of H.U. of ammonium. The x-ray study of the first dehydration step suggests the formal mechanism: $H_3O^+ + O^{2-} \rightarrow H_2O + OH^-$ by the breaking of a hydrogen bond. The powder pattern evolution with temperature shows important cation effects. The structure consists of pseudohexagonal layers of composition $(UO_2)(O,OH)_n$ ($n \leq 2$) similar to those encountered in $Ca(UO_2)O_2$ and U_3O_8. The simultaneous existence of O^{2-} and OH^- in the layer accounts for the uranium lattice without postulating a fivefold coordination for uranyl ions. The layers are connected together by the positive ions H_3O^+ and X^{2+}. (auth)

234 SINGLE CRYSTAL AND POWDER DIFFRACTION STUDIES ON CURIUM-248 TRICHLORIDE, $^{248}CmCl_3$. Peterson, J. R. (Univ. of Tennessee, Knoxville); Burns, J. H. J. Inorg. Nucl. Chem.; 35: No. 5, 1525-1530(May 1973).

A single crystal of $^{248}CmCl_3$ was grown from the melt and studied by x-ray diffraction. The UCl_3-type hexagonal unit cell has (at 23°C) dimensions of $a_0 = 7.3743(11)$ and $c_0 = 4.1850(7)$ Å, where the standard errors are given in parentheses. Structural parameters including anisotropic thermal motion were refined by the method of least-squares. A radius of 0.971(3) Å was derived for the six-coordinated cm^{3+} ion. Powder diffraction studies on three $^{248}CmCl_3$ samples indicated the apparent absence of radio-induced expansion in the previous $^{244}CmCl_3$ studies. The melting point of $^{248}CmCl_3$ was determined to be 695 ± 10°C. (auth)

235 ELECTRON MICROSCOPY OF MONOMOLECULAR LAYERS OF THORIUM ATOMS. Baumeister, W.; Hahn, M. H. (Univ., Dusseldorf, Ger.). Nature (London); 241: No. 5390, 445-447(16 Feb 1973).

A specially designed Langmuir trough was used to generate Th-hexafluoracetylacetonate monomolecular films and transfer them to thin C supports for electron microscope examination. Electron micrographs are reproduced, showing Th atom patterns. (UK)

236 SYNTHESIS OF (METHYLPHENYLPHOSPHINYL)-METHYLPHENYLPHOSPHINIC ACID AND INVESTIGATION ON THE COMPLEX FORMATION OF TRIVALENT AMERICIUM, CURIUM, AND PROMETHIUM IONS. Elesin, A. A.; Zaitsev, A. A.; Karaseva, V. A.; Nazarova, I. I.; Petukhova, I. V. Sov. Radiochem. (Engl. Transl.); 14: No. 3, 385-388(1972).

Translated from Radiokhimiya; 14: No. 3, 374-377(1972).

(Methylphenylphosphinyl)methylphenylphosphinic acid was synthesized, and the thermodynamic value of its dissociation constant ($pK^0 = 2.04$) was determined. The complex formation with Am^{3+}, Cm^{3+}, and Pm^{3+} was investigated by the method of ion exchange on a cation exchange resin at an ionic strength of 0.2 (NH_4ClO_4). The logarithms of the stability constants of the complexes are correspondingly equal to 3.35, 3.35, and 3.40, which is substantially higher than the corresponding values with phosphoric and methylphosphonic acids and approach the value of the constant with trimetaphosphoric acid. It was hypothesized that the supplementary stabilization of the complexes is due to the chelate effect, associated with closing of the ring. (auth)

237 PEROXIDE OF PENTAVALENT AMERICIUM. Musikas, C. (Commissariat a l'Energie Atomique, Fontenay-aux Roses, France). Radiochem. Radioanal. Lett.; 13: No. 4, 255-258(27 Apr 1973). (In French).

Spectrophotometric evidence is given for the existence of a peroxidic complex of Am(V) in 1M NaOH media. This complex is reduced by H_2O_2 more rapidly than the corresponding complex of Pu. (auth)

238 REDUCTION OF EINSTEINIUM AND CALIFORNIUM CHLORIDES TO THE DIVALENT STATE IN AQUEOUS ALCOHOL SOLUTIONS. Mikheev, N. B.; Spitsyn, V. I.; Kamenskaya, A. N.; Rozenkevich, N. A.; Rumer, I. A.; Auerman, L. N. Sov. Radiochem. (Engl. Transl.); 14: No. 3, 494-495(1972).

Translated from Radiokhimiya; 14: No. 3, 486-487(1972).

A study was made of the simultaneous reduction of chlorides of samarium and einsteinium or californium with magnesium in aqueous alcohol solution that results in the sparingly soluble $SmCl_2$ capturing the divalent actinide. Results indicate that cocrystallization of Es and Cf with $SmCl_2$ occur on account of true isomorphism. Consequently, these elements are reduced to the divalent state together with samarium. (DHM)

239 PROCESSES OF OXIDATION AND DISSOLUTION OF URANIUM COMPOUNDS IN NONAQUEOUS MEDIA. IV. Dissolution of UO_2 in the System TOA–HNO_3. Strelkov, L. A.; Filippov, A. P. Sov. Radiochem. (Engl. Transl.); 14: No. 3, 496-497(1972).

Translated from Radiokhimiya; 14: No. 3, 487-488(1972).

Results of an investigation of the dissolution of powdered uranium dioxide in the system trioctylamine–nitric acid–xylene showed that the oxidative activity of nitric acid is determined by the mole ratio HNO_3 : TOA in the organic solution. At values of this ratio less than 1.7 to 1.8, the process is extremely slow. In the region of higher HNO_3 concentrations in the organic phase, the process of oxidation and dissolution of UO_2 develops vigorously, reaching the highest rate at a relative concentration of HNO_3 : TOA equal to 2.5 to 3.0. It was concluded that the greatest oxidative ability is manifested by nitric acid, contained in the relatively unstable solvate TOA · HNO_3 · $2HNO_3$ · H_2O. As a result of decomposition of the latter, undissociated HNO_3 molecules, which play the role of an oxidizing agent for U(IV), are liberated. (DHM)

240 SYNTHESIS AND TEST OF PURITY OF PENICILLAMINE HYDROCHLORIDE-[2-^{14}C]. Donnert, D. (Kernforschungszentrum, Karlsruhe, Ger.); Planas Bohne, P. Arzneim.-Forsch.; 22: No. 9, 1423-1425(1972). (In German).

The synthesis of D- and L-penicillaminehydrochloride-[2-^{14}C] is described. The labeled compound differs from the unlabeled one by its higher tendency to oxidation to disulfide and its sensitivity in a solution of pH greater than 7. The applicability of the labeled compound for pharmaco-kinetic studies is discussed. (GF)

241 STUDY OF THE COMPLEX FORMATION OF Np(IV) WITH THE NITRATE ION BY THE METHOD OF SPECTROPHOTOMETRY. Barbanel, Yu. A.; Murav'eva, L. P. Sov. Radiochem. (Engl. Transl.); 14: No. 3, 498-501(1972).

Translated from Radiokhimiyia; 14: No. 3, 489-492(1972).

It was concluded from a study of the complex formation of Np(IV) in aqueous solution with a composition of xM HNO_3 + (9-x) M $HClO_4$, where $10^{-2} < x < 1$ M, that the complexes $NpNO_3^{3+}$, and $Np(NO_3)_2^{2+}$ predominate, and the changes in the concentration obey the law of mass action. The form of existence of Np to which the spectrum of Np(IV) in 1 M HNO_3 + 8 M $HClO_4$ and the analogous spectrum of Np(IV) in 5 M HNO_3 correspond is a dinitrate complex $Np(NO_3)_2^{2+}$. (DHM)

242 CHEMICAL CONSEQUENCES OF THE β-DECAY OF RaE CONTAINED IN TRIARYL DERIVATIVES OF BISMUTH. Nefedov, V. D.; Petrov, L. N.; Avrorin, V. V. Sov. Radiochem. (Engl. Transl.); 14: No. 3, 443-447(1972).

Translated from Radiokhimiya; 14: No. 3, 436-441(1972).

The chemical consequences of the β-decay of RaE contained in triparachlorophenylbismuth, triparabromophenylbismuth, and triorthotolylbismuth were studied. It was shown that in the case of comparatively small changes in the distribution of electron density, the difference in the yields of stabilization products of the primary molecular ions can be explained by a change in the energy of the Bi–C_{ar} bond in the corresponding derivatives. A correlation of the yields of the stabilization products (Q) of molecular ions with the Hammett σ_p values, satisfying the equation, $\log Q = 1.80 - 0.22\,\sigma_p$, was established. (auth)

243 PROCESSES OF OXIDATION AND DISSOLUTION OF URANIUM COMPOUNDS IN NONAQUEOUS MEDIA. III. Dissolution of Uranium Oxides in D2EHPA Solutions. Strelkov, L. A.; Filippov, A. P. Sov. Radiochem. (Engl. Transl.); 14: No. 3, 415-418(1972).

Translated from Radiokhimiya; 14: No. 3, 405-409(1972).

It was shown that the dissolution of uranium trioxide in bis(2-ethylhexyl) phosphate (D2EHPA) is determined by the water content in the organic solvent and does not depend on the degree of saturation of the extraction reagent with the acid. It was established that the effective process of oxidation and dissolution of UO_2 and U_3O_8 occurs in a D2EHPA solution saturated with nitric acid, at a HNO_3 concentration in the equilibrium aqueous phase greater than 6 M HNO_3(mole ratio HNO_{3a}/D2EHPA ≥ 0.16). The oxidizing agent for uranium (IV) in solutions of D2EHPA is molecular nitric acid, contained in the complex D2EHPA · $2HNO_3$ with a low stability constant ($\tilde{K}_2 = 1.5 \cdot 10^{-3}$). (auth)

244 PHOTOCHEMICAL REDUCTION OF URANYL NITRATE BY FORMALIN. Kireeva, G. N.; Savel'eva, V. I. Sov. Radiochem. (Engl. Transl.); 14: No. 3, 411-414(1972).

Translated from Radiokhimiya; 14: No. 3, 401-404(1972).

In an investigation of the photochemical reduction of uranyl nitrate to the tetravalent state with formalin, it was established that the optimum reduction is achieved at a ratio of uranium to formaldehyde of 1 : 10 mole/mole. An increase in the rate of the process is promoted by the introduction of the fluoride ion, in the presence of which quantitative reduction of the uranyl ion is possible. The conditions of interaction of nitric acid with formaldehyde were investigated. The quantum yields of the reaction were measured in the temperature interval 10 to 50°C. (auth)

245 COMPOUNDS OF TETRAVALENT URANIUM. Grinberg, A. A.; Petrzhak, G. I.; Lozhkina, G. S.; Karago, L. V. Sov. Radiochem. (Engl. Transl.); 14: No. 3, 407-410(1972).

Translated from Radiokhimiya; 14: No. 3, 397-400(1972).

A quantitative determination was made of the carbon dioxide liberated during the dissolution of uranium oxalate in ammonium bicarbonate. The data obtained show that in the interaction of uranium oxalate with ammonium bicarbonate, taken in the ratios HCO_3^- : U(IV) = 5 : 1, 7 : 1, and 8 : 1, the same amount of carbon dioxide is liberated, namely, 2 moles of CO_2 per mole of U(IV). The complex formed when uranium(IV) oxalate was dissolved in ammonium bicarbonate and then reacted with hexacarbamido chromium(III) chloride has the composition $[Cr(N_2H_4CO)_6]_3NH_4[U_2(CO_3)_8 \cdot C_2O_4] \cdot 6\,H_2O$. Infrared spectrum of the mixed oxalate–carbonate complex of uranium is also presented. (DHM)

246 BEHAVIOR OF URANIUM MONOSULFIDE DURING OXIDATION. Koval'chuk, V. Yu.; Zhirov, A. I.; Dunaeva, K. M.; Ippolitova, E. A. Sov. Radiochem. (Engl. Transl.); 14: No. 3, 401-406(1972).

Translated from Radiokhimiya; 14: No. 3, 391-397(1972).

The oxidation of uranium monosulfide by oxygen and air was studied by the methods of DTA, TGA, x-ray phase, and chemical analyses. Oxidation products of the monosulfide in the temperature interval 150 to 600°C are oxides of uranium and uranyl sulfate. Optimum conditions of formation of uranyl sulfate (yield ~20%) are the temperatures: 325°C (in the case of air) and 365°C (in the case of oxygen). The nature and sequence of the reactions occurring in the oxidation of uranium monosulfide were detected. Formation of oxides with the composition UO_{2+x} occurs as a result of the interaction of unreacted uranium monosulfide with the uranyl sulfate formed (temperature region 360 to 440°C). At a higher temperature these oxides of uranium, which were formed as a side product, are oxidized to uranium octoxide. (auth)

247 CHEMICAL SHIFTS OF THE $L_{\alpha 1}$ X-RAY LINE OF U IN CHLORINE- AND OXYGEN-CONTAINING COMPOUNDS OF URANIUM. Vdovenko, V. M.; Makarov, L. L.; Suglobova, I. G.; Volkov, V. A.; Chibisov, N. P. Sov. Radiochem. (Engl. Transl.); 14: No. 3, 395-400(1972).

Translated from Radiokhimiya; 14: No. 3, 384-390(1972).

The chemical shifts of the $L_{\alpha 1}$ line of U were measured for 19 pairs of compounds. The experimental data were interpreted within the framework of the model of donor–acceptor interaction. The contributions to the chemical shift from the participation of electrons of different symmetry, the degree of ionic character of the bond, and the effective charges on the U atom were estimated. Probable valence structures were proposed for the U atom, in a number of cases (UCl_6^{--}, UO_3) with the participation of 5f electrons. The compatibility of the results obtained with the data of relativistic calculations of the one electron levels of uranium was demonstrated. The chemical shifts of the $L_{\alpha 1}$ line in the series of compounds of the hexochlorouranate ion are correlated with the data of the ir-spectra. (auth)

248 COMPLEX FORMATION OF TRIVALENT AMERICIUM, CURIUM, AND PROMETHIUM IONS WITH DIETHYLPHOSPHINYLPROPIONIC ACID. Elesin, A. A.; Zaitsev, A. Sov. Radiochem. (Engl. Transl.); 14: No. 3, 381-384(1972).

Translated from Radiokhimiya; 14: No. 3, 370-374(1972).

By an investigation of the sorption of americium, curium, and promethium on the cation exchange resin KU-2 as a function of the concentration of diethylphosphinylpropionic acid (DEPPA), the existence of complex ions of americium and promethium with one and two ligands was established. For curium the data were obtained in a narrower range of DEPPA concentrations, and therefore only the complex with one ligand was identified. By a comparison of the dissociation constants of the acids and the stability constants of complexes of americium with acetate and DEPPA, it was shown that a supplementary bond with the ≡ P = O group is not realized. (auth)

249 COMPLEX FORMATION IN SOLUTIONS OF THORIUM NITRATE ACCORDING TO THE DATA OF IR SPECTRA. Vdovenko, V. M.; Statsevich, V. P.; Suglobov, D. N. Sov. Radiochem. (Engl. Transl.); 14: No. 3, 377-380(1972).

Translated from Radiokhimiya; 14: No. 3, 366-370(1972).

The ir spectra of a number of organic solutions of thorium nitrate were investigated. The spectra studied show the presence only of coordinated NO_3 groups; the bands of "ionic" nitrate are not present in the spectra. An estimate of the degree of ionization of thorium nitrate in dioxane–water mixtures was given on the basis of the spectroscopic data. A complex dependence of the behavior of the band ν_{3b} on the thorium nitrate concentration in aqueous solution was detected. (auth)

250 COCRYSTALLIZATION OF Np, Pu, Am, AND Cm WITH DICHLORIDES OF SAMARIUM AND EUROPIUM IN AQUEOUS ETHANOL SOLUTIONS. Mikheev, N. B.; Kamenskaya, A. N.; D'yachkova, R. A.; Rozenkevich, N. A.; Rumer, I. A.; Auerman, L. N. Sov. Radiochem. (Engl. Transl.); 14: No. 3, 476-477(1972).
Translated from Radiokhimiya; 14: No. 3, 471-473(1972).

In a study of the cocrystallization of Am, Pu, Cm, and Np with $SmCl_2$ and $EuCl_2$, it was found that all the actinides cocrystallize with both $SmCl_2$ and $EuCl_2$. In a study of the cocrystallization of microquantities of Sm, Eu, Yb, and Ce with $EuCl_2$ and $SmCl_2$ it was found that Sm and Yb do not cocrystallize with $EuCl_2$. The absence of cocrystallization of Sm and Yb indicates that in the formation of $EuCl_2$ in the system, the potential sufficient for the reduction of Sm and Yb to the divalent state is not reached. Data show that the coefficients of cocrystallization of the investigated actinide elements and Ce decrease sharply in the presence of macroquantities of $LaCl_3$. Thus, the cocrystallization of Np, Pu, Am, Cm, and Ce with $EuCl_2$ and $SmCl_2$ is due to the formation of anomalous mixed crystals. (DHM)

251 HYDROLYSIS OF NEPTUNIUM(VII). Chaikhorskii, A. A.; Leikina, E. V. Sov. Radiochem. (Engl. Transl.); 14: No. 3, 389-394(1972).
Translated from Radiokhimiya; 14: No. 3, 378-384(1972).

As a result of pH-metric titration of a 2.5×10^{-3} M solution of neptunium(VII) with perchloric acid, the following data were obtained. In the range of pH = 12.5 to 14 neptunium(VII) is stable in solution and exists in the form of a "green" complex, to which the formula NpO_3^{2-} is ascribed. The higher the alkali concentration in solution, the more stable the NpO_3^{2-} anion. At pH = 12.5 in solution, the rate of reduction of neptunium(VII) increases substantially; the higher the temperature of the solution, the higher the rate of reduction of neptunium(VII). Within the range of pH = 12.5 to 11.8, neptunium(VII), undergoing partial reduction, is converted to a "yellow" complex of neptunium(VI), which is not noticeable against the background of the green solution. At pH = 11.8, slight turbidity appears, and a rust-colored precipitate of neptunium(VI) is formed. The lower the temperature of the solution and the lower the acid concentration in the solution to be titrated, the less of the neptunium(VI) precipitate is formed. This precipitate does not dissolve in a 2 N solution of lithium hydroxide and is not titrated by a solution of hydrogen peroxide. The bulk of the neptunium in solution (~85 to 99%) is in the heptavalent form and has a green color. (auth)

252 DETERMINATION OF THE STANDARD REDOX POTENTIAL OF THE TRANSITION $Me^{2+} \rightleftharpoons Me^{3+} + e$ FOR Cf AND Es. Mikheev, N. B.; Rumer, I. A. Sov. Radiochem. (Engl. Transl.); 14: No. 3, 502-503(1972).
Translated from Radiokhimiya; 14: No. 3, 492-493(1972).

The standard redox potential of the transition $Me^{2+} \rightleftharpoons Me^{3+} + e$ for Es is equal to $(E^0_{Sm^{2+}, Sm^{3+}} - 0.004) \pm 0.04$ V, and for Cf – $(E^0_{Sm^{2+}, Sm^{3+}} - 0.05) \pm 0.04$ V. It is known that $E^0_{Sm^{2+}, Sm^{3+}} = -1.55$ V for aqueous solutions. As we go from alcohol solutions, for which the values of the distribution coefficients were obtained, to aqueous solutions the standard redox potentials change by no more than 30%. Considering this, it follows that for aqueous solutions $E^0_{Es^{2+}, Es^{3+}} = -(1.55 \pm 0.06)$ V, while $E^0_{Cf^{2+}/Cf^{3+}} = -(1.60 \pm 0.08)$ V. (auth)

253 COMPLEX FORMATION IN THE SYSTEMS URANIUM HALIDE–ALKALI METAL HALIDE. Thermographic and X-Ray Diffraction Studies of Binary System UCl_4–RbCl. Vdovenko, V. M.; Volkov, V. A.; Kozhina, I. I.; Suglobova, I. G. Sov. Radiochem. (Engl. Trans.); 14: No. 3, 492-493(1972).
Translated from Radiokhimiya; 14: No. 3, 484-485(1972).

An analysis of the x-ray diffraction patterns, as well as a comparison of these results with the results of a thermographic investigation, revealed that the system UCl_4–RbCl has two eutectic points: e_1 with composition 45 mole % Rb, mp = 350°C, and e_2 with composition 76 mole % RbCl, mp = 530°C; three coordination compounds are formed in the binary system: $RbUCl_5$, Rb_2UCl_6, and Rb_4UCl_8. The first melts incongruently at 360°C, the second melts congruently at 674°C, and the third melts incongruently at 560°C. (DHM)

254 COMPLEX FORMATION IN THE SYSTEMS URANIUM HALIDE–ALKALI METAL HALIDE. Thermographic and X-ray Diffraction Investigations of the Binary System UCl_4–CsCl. Vdovenko, V. M.; Volkov, V. A.; Kozhina, I. I.; Suglobova, I. G. Sov. Radiochem. (Engl. Transl.); 14: No. 3, 489-491(1972).
Translated from Radiokhimiya; 14: No. 3, 482-484(1972).

An analysis of the x-ray diffraction patterns, as well as a comparison of these results with the results of a thermographic investigation, revealed that the binary system UCl_4–CsCl has two eutectic points: e_1, with composition 41 mole % CsCl with mp 360°C; and e_2 with composition 81 mole % CsCl, with mp 498°C; three coordination compounds are formed in the system CsU_2Cl_9, $CsUCl_5$, Cs_2UCl_6. The first melts incongruently at 387°C; the second melts incongruently at 420°C; and the last melts congruently at 665°C. The temperature stops at 445°C correspond to the polymorphic transformation of CsCl. (DHM)

255 PHOSPHINE OXIDE COMPLEXES OF THE ACTINIDE-(4) THIOCYANATES. Al-Kazzaz, Z. M. S. (Univ. of Manchester, Eng.); Bagnall, K. W.; Brown, D. J. Inorg. Nucl. Chem.; 35: No. 5, 1501-1507(May 1973).

Phosphine oxide complexes of composition $M(NCS)_4(R_3PO)_4$ (R = Me, M = U, Np,Pu; R = NMe_2, M = Th,U,Np,Pu; R = Ph, M = Th,U,Np), $Th(NCS)_4(tmpo)_6$ (tmpo = trimethylphosphine oxide), and $M(NCS)_4(ompa)_2$ (ompa = octamethylpyrophosphoramide) (M = Th,U,Np) were prepared from the corresponding phosphine oxide complexes of the actinide tetrachlorides. The tppo (triphenylphosphine oxide) and ompa complexes of $Pu(NCS)_4$ were prepared in the same way but could not be obtained pure. The ir and uv/visible spectra of these compounds are reported. (auth)

256 SOME PHOSPHINE OXIDE COMPLEXES OF THE ACTINIDE TETRACHLORIDES. Al-Kazzaz, Z. M. S. (Univ. of Manchester, Eng.); Bagnall, K. W.; Brown, D. J. Inorg. Nucl. Chem.; 35: No. 5, 1493-1500(May 1973).

Trimethylphosphine oxide (tmpo) complexes, $MCl_4(tmpo)_6$ (M = Th, Pa, U, Np, Pu), $UCl_4(tmpo)_3$ and $MCl_4(tmpo)_2$ (M = U, Np), octamethylpyrophosphoramide (ompa) complexes $MCl_4(ompa)_{1.5}$ (M = Np, Pu) and the plutonium tetrachloride complexes $PuCl_4L_2$ (L = tppo (triphenylphosphine oxide, hmpa (hexamethylphosphoramide)) were prepared by reactions in nonaqueous solvents. The ir spectra of these compounds are reported, together with crystallographic and spectral data for some of the compounds. (auth)

257 URANOCENES WITH HYDROCARBON SUBSTITUENTS. Streitwieser, A. Jr.; Harmon, C. A. (Univ. of California, Berkeley). Inorg. Chem.; 12: No. 5, 1102-1104(May 1973).

The preparation and physical and chemical properties of uranocene (bis(π-cyclooctatetraene)-uranium) derivatives from the following cyclooctatetraenes: ethyl, n-buty-, vinyl, phenyl, cyclopropyl, and 1, 3, 5, 7-tetramethyl are described. The alkyl-substituted uranocenes show bathochromic shifts in the visible spectrum interpreted as charge-transfer transitions. A mixture of 1,1'-diethyl- and 1,1'-di-n-butyluranocenes gave no 1-ethyl-1'-n-butyluranocene on heating. 1,1'-Divinyluranocene is converted to 1,1'-diethyluranocene by hydrogenation and to 1,1'-dicyclopropyluranocene with the Simmons–Smith reagent. These results are consistent with the formulation of uranocene as an f-orbital metallocene. (auth)

258 BIS(ALKYLCYCLOOCTATETRAENYL)ACTINIDE(IV) COMPOUNDS. Karraker, D. G. (E. I. du Pont de Nemours and Co., Aiken, SC). Inorg. Chem.; 12: No. 5, 1105-1108(May 1973).

Bis(ethylcyclooctatetraenyl) ($C_8H_7C_2H_5^{2-}$ = EtCOT) and bis(n-butylcyclooctatetraenyl) ($C_8H_7C_4H_9^{2-}$ = BuCOT) compounds of U(IV), Np(IV), and Pu(IV) were synthesized and characterized. X-ray diffraction patterns showed the three $M(EtCOT)_2$ compounds were isomorphous, and the three $M(BuCOT)_2$ compounds were isomorphous in a different structure. The magnetic susceptibilities of $M(EtCOT)_2$ and $M(BuCOT)_2$ compounds (M = 4+ actinide ion) are almost identical with $M(COT)_2$ compounds and suggest a "sandwich" structure for $M(EtCOT)_2$ and $M(BuCOT)_2$. The Mössbauer spectra of all three Np^{4+} compounds are identical within experimental error. Alkyl substitution on the COT ligand results in a shift to longer wavelengths for strong absorption bands in the visible region. This shift is attributed to an increase in electron density on the COT ligands, and these absorption bands are attributed to molecular transitions, rather than 5f-5f transitions of the M(IV) ions. (auth)

259 URANIUM–OXYGEN LATTICE VIBRATIONS OF TRIURANIUM OCTOXIDE. Ohwada, K.; Soga, T. (Japan Atomic Energy Research Inst., Tokai). Spectrochim. Acta, Part A; 29: No. 5, 843-850(May 1973).

A tentative assignment of the ir spectrum for triuranium octoxide was made by assuming two structure models of infinite hexagonal UO_3 and UO_2. It was found that all the ir absorption bands previously observed in the region from 4000 to 90 cm^{-1} are well explained by the assumption of such models. In order to obtain the approximate force constants of the uranium–oxygen bonds in triuranium octoxide, the normal coordinate analysis of the optically active U–O lattice vibrations was made on the basis of the two models. The force constants of U–O bonds were obtained and discussed in some detail. (auth)

260 PURIFICATION OF TRITIATED PHENACETIN AND N-ACETYL-P-AMINOPHENOL. Singh, H. P.; Gault, M. H. (Queen Mary Veterans Hospital, Montreal). J. Label. Compounds; 8: No. 4, 595-599(1972).

Phenacetin and N-acetyl-p-aminophenol (NAPA) tritiated by catalytic exchange were quite impure as purchased. No previous re-

ports on purification of these radioactive compounds could be found, although there are reports of separation of phenacetin or NAPA by chromatography. Purification was carried out in two steps: gel filtration with Sephadex G-10, followed by thin layer chromatography on silica gel. (auth)

261 PREPARATION OF [^{18}F]5-FLUORO-DOPA WITH REACTOR PRODUCED ^{18}F. Firnau, G.; Nahmias, C.; Garnett, S. (McMaster Univ., Hamilton, Ont.). Int. J. Appl. Radiat. Isotop.; 24: No. 3, 182-184(Mar 1973).

It is suggested that 3,4-dihydroxy-phenylalanine (DOPA) suitably labelled could be a specific brain scanning agent to visualize neoplastic or vascular lesions by means of external detectors. ^{18}F is a suitable label for DOPA due to its high photon yield and short half-life of 110 min. A method is described by which ^{18}F-fluoro-DOPA can be routinely synthesized within two half-lives of ^{18}F at specific activities from 0.2 to 2.0 μCi/mg. This value can probably be increased to 12 μCi/mg. (UK)

262 SELECTION OF THE SYNTHESIS CONDITIONS FOR POORLY SOLUBLE SALTS OF THE M_2A_3 TYPE. Mokhosoev, M. V.; Tokareva, L. R. (Donetsk State Univ., USSR). Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 9, 1413-1416(Sep 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 9, 1610-1614(Sep 1972).

Equations were derived enabling the determination of the optimal pH and initial concentrations for synthesis of poorly soluble M_2A_3 salts, thus making controlled synthesis possible. These equations were used to select the precipitation conditions for molybdates of Al, Ga, In, Sc, Y, La, and Ac. Calculations show that for elements of the Al subgroup, neutral Al and In molybdates may be synthesized from aqueous solutions. Precipitation of Ga molybdate is impeded, because its region of formation has been distinguished only for very dilute solutions (m = 0.025 mole/liter) and the SP of salt cannot be attained. Tellurium molybdate cannot be synthesized from aqueous solutions. The formation regions of molybdates of elements of the Sc subgroup were distinguished. It is shown that the formation region of neutral molybdates increases with decreasing MoO_4^{2-} concentration; for the same concentration, ΔpH increases with the ionic radius of the cation. (auth)

263 PALLADIUM SULFIDE AS CATALYST FOR REDUCTION OF THE URANYL ION. Sokolova, I. D.; Savel'eva, V. I.; Gromov, B. V.; Ryashentseva, M. A.; Minachev, Kh. M. J. Appl. Chem. USSR (Engl. Transl.); 45: No. 9, 2027-2029(Sep 1972).

Translated from Zh. Prikl. Khim.; 45: No. 9, 1938-1941(Sep 1972).

Palladium sulfide can be used as a catalyst for reduction of uranyl ions by formaldehyde in acid solutions. The effectiveness of reduction of uranyl ions depends to a considerable extent on the temperature, the amount of catalyst, and the anions present in solution. Palladium sulfide is not poisoned under the conditions studied and can be used repeatedly without regeneration. (auth)

Radioactive Waste Treatment

Refer also to abstracts 360–362, 946, and 947.

264 *INCINERATION OF RADIOACTIVE WASTE AT THE* STRASBOURG-CRONENBOURG CNRS LABORATORIES. Delarue, R. (Carbonisation Entreprise et Ceramique, Montrouge, France); Pradel, J.; Teissier, C. Ind. At. Spatiales; 16: No. 5, 53-64(Sep 1972). (In French).

The CNRS radioactive waste incinerator at Strasbourg-Cronenbourg treats, principally, the bodies of small animals from biology laboratories where they have been labeled with radioisotopes. Certain contaminated liquid fuels are also handled. The apparatus consists of a CEC patented grid and a CEA patented after-combustion chamber. This chamber ensures the complete combustion of the materials treated. This chamber is followed by a high-temperature, high-efficiency gas filter patented by the CEA, a gas cooler and an absolute filter. The assembly is constructed from corrosion resistant material. Permanent measuring equipment demonstrated that the gases released by the chimney were always less than the MPC. The environmental atmosphere was always very much below the values measured at the chimney due to dilution effects. The installation is provided with various safety and alarm devices, which ensure safe operation in the event of the failure of a component of the system. The incineration costs vary between 2.24 and 3.56 F/kg (deterioration and maintenance of the equipment being included) depending upon the annual usage. (France)

265 RUTHENIUM DECONTAMINATION OF LIQUID WASTES PRODUCED IN THE REPROCESSING OF NUCLEAR FUELS. Berton, Y.; Chauvet, P.; Clapit, S.; Fernandez, N. (to Commissariat a l'Energie Atomique). French Patent 2,124,126. 22 Sep 1972. Filed date 8 Feb 1971. 5p. (In French).

A process for the Ru decontamination of liquid wastes arising in the reprocessing of fuels is presented. It consists of adding ferrous ions and copper ions to the solution after having reacted this solution with an oxidizing agent, alkalizing the solution to precipitate the copper and iron compounds, coagulating and filtering the sludge obtained. Sufficient quantities of oxidizing agent (potassium permanganate) are added to the initial solution. Copper ions are added in the form of an aqueous solution of a copper salt, e.g., the sulfate, in order to establish copper ion concentration of between 80 and 200 $mg \cdot l^{-1}$ in the effluent. Ferrous ions are added in the form of an aqueous ferrous sulfate solution in order to establish a ferrous ion concentration of between 300 and 500 $mg \cdot l^{-1}$. The solution is alkalized by adding sufficient quantities of sodium hydroxide to produce a pH value lying between 7 and 8.5. The sludge produced in the preliminary processing is reused to process the crude effluent. (FR)

266 TREATMENT OF WASTE WATERS IN NUCLEAR POWER STATIONS. Heitmann, H. C. Aufbereit.-Tech.; 12: No. 5, 281-284(1971). (In German).

Outlines of the quantities of radioactive waste waters produced in nuclear power stations and details of their activities are given. The treatment of waste waters in nuclear power stations provided with pressurized water reactors and with boiling water reactors is described. In addition, reference is made to further treatment of the liquid concentrates to become storable products. It is indicated that it is possible today to treat waste waters produced in nuclear power stations in such a way that any danger to environment will be excluded. The requirements laid down for comprehensive environmental protection are fully met by nuclear power stations, not only as regards the waste gases discharged but also with respect to the waste waters produced. (auth)

267 SEPARATION AND PURIFICATION OF RADIOISOTOPES IN CYCLOTRON-BOMBARDED TARGETS. Nozaki, T. (Inst. of Physical and Chemical Research, Wako, Japan). Proc. Jap. Conf. Radioisotop.; No. 10, 476-479(Apr 1972). (In Japanese).

A description is given of the separation by distillation and sublimation, extraction with solvents, ion exchange, coprecipitation, and adsorption with colloids. For example, ^{111}In is prepared from silver as follows: silver is dissolved in nitric acid. After the addition of a large amount of NH_4SCN and NaOAc, ^{111}In is extracted with methyl isobutyl ketone. Then it is counter-extracted with dilute hydrochloric acid. This solution is purified using a cation exchange resin. Then the salt concentration and pH are adjusted. For the production of ^{7}Be by the irradiation of metallic lithium, the target is first dissolved in hydrochloric acid, followed by coprecipitation with a small amount of iron hydroxide. The precipitate is dissolved in concentrated hydrochloric acid. Iron is then removed by either anion exchange or by solvent extraction. For the production of ^{43}K, irradiation is performed in a circulating flow of argon. Then ^{43}K is absorbed at a definite position very easily. Therefore, it is dissolved out by dilute hydrochloric acid. Irradiation of B_2O_3 in a helium flow liberated $^{11}CO_2$ and ^{11}CO into the gas flow. The gas is cooled with a liquid nitrogen trap to collect $^{11}CO_2$ and ^{11}CO. The method of selecting procedures is discussed from a general point of view. (Japan)

268 CHEMICAL PROBLEMS IN THE INVESTIGATION OF SUPERHEAVY ELEMENTS. Baechmann, K. (Technische Univ., Darmstadt, Ger.). Proc. Jap. Conf. Radioisotop.; No. 10, 149-159 (Apr 1972).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

An on-line investigation of a single short-lived nuclide requires separation of different elements and of different masses. A separation of different elements is achieved by means of chemical procedures whereas a mass separator separates out different masses. The use of "thick" targets leads to a first elimination of elements due to the formation of volatile compounds and different diffusion velocities. A "thin" target makes it necessary to stop the recoils either in an inert gas (helium jet) or in a reactive gas (which forms a volatile compound), or finally in a solid catcher. Another separation is possible between target and ion source using condensation, adsorption, or chemisorption. A very fast technique is a combination of target and ion source. A final chemical step may be carried out at the collector of a mass separator. Some possible arrangements for the investigation of short-lived nuclides are discussed. (auth)

Radioisotope Production

Refer also to abstracts 964, 1012, and 1023.

269 (CONF-730309-3) SEPARATED ISOTOPE TARGETS FOR RADIOISOTOPE PRODUCTION. Rupp, A. F. (Oak Ridge National Lab., Tenn.). 1972. 16p. (SM-171/35). Dep. NTIS.

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973).

The use of separated isotope targets for radioisotope production is considered with respect to both reactor and accelerator targets. Target elements, both radioactive and stable, that are altered in *isotopic composition or produced by nuclear transformation* are discussed. (DHM)

270 *(NP-19651) PRODUCTION OF ^{197}Hg AND ITS LABELLED COMPOUNDS.* Mustafa, H.; Doekmen, M.; Guelbaba, G. (Cekmece Nuclear Research and Training Center, Istanbul *(Turkey)). 1972. 30p. (In Turkish). Dep. NTIS (U. S. Sales* Only).

The nuclear properties, half-life, decay mode, energies and intensities of the γ spectrum, etc. of ^{197}Hg were reviewed, describing also the method used to produce these nuclides by the neutron bombardment of mercury. *Activities were calculated for various* target thicknesses, neutron fluxes and periods of bombardment. Several chemical processes used to dissolve the irradiated targets were mentioned. The application of ^{197}Hg medicine was discussed together with techniques used to prepare some labeled ^{197}Hg compounds, and to check their purity by γ spectrometry and by radio*chemical means. (TTT)*

271 (NP-19711) SEPARATION AND PURIFICATION OF FISSION PRODUCTS. Report No. 92. Bilge, A. N. (Cekmece Nuclear Research and Training Center, Istanbul (Turkey)). 1972. 57p. (In Turkish). Dep. NTIS (U. S. Sales Only) $5.00.

Experiments were carried out with various amounts of metallic uranium, UO_3, metallic plutonium, and thorium as targets. The elements As, Br, Sr, Y, Zr, Nb, Mo, Pd, Ag, Cd, Te, I, Cs, Ba, and Ce were obtained as fission products. Several processes were developed to dissolve the bombarded targets in various solutions in *order to separate out certain fission products and to purify the* radioactive isotopes thus obtained. The required running time and efficiency of recovery of the methods are presented. (TTT)

272 ADSORPTION CHARACTERISTICS OF TIN-113 AND INDIUM 113m ON SILICA GEL, ALUMINA, AND DOWEX 1 FROM *HYDROCHLORIC ACID MEDIUM.* El-Garhy, M.; Palma, T.; Lorca, E. (Comision Chilena de Energia Nuclear, Santiago de Chile). J. Inorg. Nucl. Chem.; 35: No. 5, 1703-1705(May 1973).

The adsorption characteristics of tin(IV) and indium(III) from *HCl medium on silica gel, alumina, and Dowex 1 were investigated* to determine the best conditions for separations of indium-113m from tin-113. The results are presented graphically, as K_d, the distribution coefficient, vs HCl molarity in the aqueous phase. The separation factors are shown on the curves, and the most *suitable working region for the separation of indium from tin.* (UK)

273 RELATIVE VOLATILITIES OF THE METALS URANIUM, CALIFORNIUM, AND FERMIUM. Merinis, J.; Legoux, Y.; Bouissieres, G. (Institut de Physique Nucleaire, Orsay, France). *Radiochem. Radioanal. Lett.; 13: No. 4, 221-225(27 Apr 1973).* (In French).

^{250}Fm and ^{246}Cf produced in uranium metal target irradiated with ^{16}O ions can be quickly removed with a good yield by high vacuum volatilization above the melting point. (auth)

274 LOW-BACKGROUND β-RAY SPECTROMETRIC ESTIMATION OF THE ELAPSED TIME AFTER SEPARATION OF ^{95}Zr FROM ^{95}Zr–^{95}Nb IN RADIOACTIVE EQUILIBRIUM. Shibata, S.; Kawamura, S. (National Inst. of Radiological Sciences, Chiba, Japan). Radiochem. Radioanal. Lett.; 13: No. 4, 245-254(27 Apr 1973).

A possibility of determining the elapsed time "t" after separation of ^{95}Zr from ^{95}Zr–^{95}Nb in radioactive equilibrium, or of the activity ratio "R" of ^{95}Nb + ^{95m}Nb to ^{95}Zr was investigated by using a low-background β spectrometer. β spectra of ^{95}Nb + ^{95m}Nb or ^{95}Zr were followed as a function of time and equations for the calculation of "t" and "R" were derived. Large deviation from the true value was observed both for "t" and "R" for the initial *periods up to 10 days, but the deviation became relatively minor* for the period of about 10 to 98 days. The present method can be applied to ^{95}Zr samples of low-level radioactivity for the semiquantitative determination of "t" and "R". (auth)

275 PRODUCTION AND SEPARATION OF CARRIER-FREE ^{111}In. Helus, F.; Maier-Borst, W. (Krebsforschungszentrum Institut fuer Nuklearmedizin, Heidelberg). Radiochem. Radioanal. Lett.; 13: No. 4, 271-278(27 Apr 1973).

^{111}Indium is produced by bombardment of silver foil targets with 21-MeV α particles. The method of separating radioindium from radioactive and chemical contamination is described. The yield in ^{111}In is 80 μCi/μAh. (auth)

276 OPTIMUM CONDITIONS OF IRRADIATION OF CALCIUM TARGETS FOR THE PRODUCTION OF PREPARATIONS OF ^{47}Sc WITH A SET VALUE OF A ^{46}Sc IMPURITY. Levin, V. I.; Malinin, A. B.; Sivenkova, O. L. Sov. Radiochem. (Engl. Transl.); 14: No. 3, 506-508(1972).

Translated from Radiokhimiyia; 14: No. 3, 494-496(1972).

The values of the ^{46}Sc impurity in ^{47}Sc were calculated in the *case of irradiation of calcium targets in neutron fluxes from* 10^{13} to 10^{14} neutrons/cm^2 · sec for 3 to 25 days. The systems of irra*diation of the targets for the production of preparations of* ^{47}Sc with a set level of ^{46}Sc impurity were determined. (auth)

277 PREPARATIVE SEPARATION OF ^{144}Ce–^{90}Y BY THE *METHOD ELECTROFOCUSING OF IONS.* Shvedov, V. P.; Semanov, G. N. Sov. Radiochem. (Engl. Transl.); 14: No. 3, 504-505(1972).

Translated from Radiokhimiyia; 14: No. 3, 493-494(1972).

An apparatus is described for the separation of Ce and Y by *electrofocusing of ions using quartz sand as carrier. It is pos*sible to separate a mixture of Ce and Y in the presence of a total concentration of them of 1 mg/ml. The purity of the products separated was equal to ^{144}Ce 99.9% and ^{90}Y 99.0%. (DHM)

278 FORMATION OF ^{46}Sc IN THE IRRADIATION OF CALCIUM *IN HIGH NEUTRON FLUXES.* Levin, V. I.; Malinin, A. B.; Kurchatova, L. N. Sov. Radiochem. (Engl. Transl.); 14: No. 3, 453-457(1972).

Translated from Radiokhimiya; 14: No. 3, 447-450(1972).

An impurity of ^{46}Sc was detected in preparations of ^{45}Ca produced by irradiation of targets of the natural isotopic composition and *enriched with respect to ^{44}Ca. The amount of this impurity in*creases as a nonlinear function of the intensity of the neutron flux and is about 1% of the activity of ^{45}Ca in the case of irradiation for 175 days in a neutron flux of 1.5×10^{14} neutrons/cm^2 · sec. It was shown that the formation of ^{46}Sc in quartz targets occurs as a *result of a nuclear reaction of secondary capture of a neutron* ^{44}Ca(n,γ)^{45}Ca $\xrightarrow{\beta^-}$ ^{45}Sc(n,γ)^{46}Sc. Calculations of the accumulation of ^{46}Sc, performed according to this scheme, were in good agreement with the experimental data. *A method was developed for the* purification of preparations of ^{45}Ca from ^{46}Sc by passing a solution *of the irradiated target in hydrochloric acid (with a 0.1 to 1.0 N* excess of HCl) through a column filled with granulate Teflon, coated with a film of bis(2-ethylhexyl)phosphate. (auth)

279 *PRODUCTION OF GALLIUM-67 WITHOUT A CARRIER.* Levin, V. I.; Malinin, A. B.; Marygina, A. B. Sov. Radiochem. (Engl. Transl.); 14: No. 3, 469-471(1972).

Translated from Radiokhimiya; 14: No. 3, 462-465(1972).

As a result of the study of the extraction of trace amounts of gallium from *hydrochloric acid solutions, it was established that* gallium without a carrier is well extracted by diethyl and diisopropyl ethers, especially the latter. In preparation of ^{66,67}Ga isolated by extraction with diisopropyl ether in the reprocessing of zinc targets irradiated with deuterons or protons, in the investigation of radioisotopic purity no other radioactive isotopes than ^{66}Ga *and ^{67}Ga were detected. According to the data of analysis, the con*tent of stable zinc in the product was about 0.5 mg. This value is less than that obtained in model experiments and corresponds to a coefficient of purification of about 10^5. The yield of ^{67}Ga was 97 to 98%. (auth)

280 PRODUCTION OF SHORT-LIVED ISOTOPES BY CHARGED PARTICLE ACCELERATORS. Cohen, B. L. (Univ. of Pittsburgh). Phys. Med. Biol.; 18: No. 2, 286-287(Mar 1973).

A brief criticism is recorded of a previous technical note (Cohen, B. L. and Canada, T. R., Phys. Med. Biol., 17, p. 416 (1972)). *This was concerned with the Van de Graaff accelerator* production of shortlived radionuclides such as ^{11}C (20 min), ^{13}N (10 min), ^{15}O (2 min) and ^{18}F (112 min), for medical appli*cations. It is suggested that there was an overestimation of the* average cross section for the production of ^{11}C and ^{15}O with 6 and 12 MeV deuterons. Target yield and reduction in yield due to labelling purification and decay, are considered, together with problems of coordination and administration. A comparative *mention is made of production by high flux cyclotrons. (UK)*

281 PRODUCTION OF SHORT-LIVED ISOTOPES BY CHARGED PARTICLE ACCELERATORS. Phelps, M. E.; Wieland, B. W. (Washington Univ., St. Louis). Phys. Med. Biol.; 18: No. 2, 284-286(Mar 1973).

A brief reply is recorded to criticisms of a previous technical note (Cohen, B. L., and Canada, T. R., Phys. Med. Biol., 17, p. 416, (1972)). This was concerned with the Van de Graaff accelerator production of shortlived radionuclides for medical applications. The present note makes particular reference to the production of ^{11}C from boron. (UK)

282 GAS-FLOW POWDER TARGET FOR THE CYCLOTRON PRODUCTION OF PURE ^{123}I. Sodd, V. J.; Blue, J. W.; Scholz, K.

K. L.; Oselka, M. C. (Univ. of Cincinnati). Int. J. Appl. Radiat. Isotop.; 24: No. 3, 171-177(Mar 1973).

A gas-flow ^{122}Te powder target is described for the production of ^{123}I via the $^{122}Te(^4He,3n)^{123}Xe \xrightarrow{\beta^+} {}^{123}I$ reaction. Iodine-123 yields in the range of 2 to 4 mCi/h were obtained from 1 to 1.5 g ^{122}Te (≈96%) targets bombarded with 42-MeV α particles at beam currents of 50 μA. At typical bombardment conditions, the ^{124}I contamination can be held to as low as 0.001%. The ^{125}I contamination which results from decay of ^{125}Xe collected in the liquid nitrogen trap was 0.4%. No other radioiodine contamination was detectable. Analysis of Ge(Li) spectra of high-purity ^{123}I showed energies and relative intensities of 13 previously unreported gamma lines at 198.5, 207.5, 330, 454.0, 554, 561, 697.5, 836.4, 876.9, 894, 908, 1035, and 1067 keV. The same target could also be used to produce ^{123}I via the $^{122}Te(^3He,2n)^{123}Xe \xrightarrow{\beta^+} {}^{123}I$ and $^{123}Te(^3He,3n)^{123}Xe \xrightarrow{\beta^+} {}^{123}I$ reactions. (auth)

283 PRODUCTION OF TRANSPLUTONIUM ELEMENTS. Ueno, K. (Japan Atomic Energy Research Inst., Tokai). Proc. Jap. Conf. Radioisotop.; No. 10, 241-243(Apr 1972). (In Japanese). From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

Various methods of producing transplutonium elements are reviewed. They are largely divided into milking and synthesis by nuclear reactions. As for the milking, 100 mg of ^{241}Am was recovered from Pu containing several per cent of ^{241}Pu at JAERI. On irradiation with nuclear reactors, the following examples are cited: production of ^{242}Cm by the (n,γ) reaction with ^{241}Am; production of ^{252}Cf starting with ^{241}Am by the use of high flux reactors such as HFIR; chemical separation of the transplutonium elements from fission products and from each other. At JAERI, by irradiating ^{241}Am in JRR-2 ($\sim 10^{13}$ n/cm^2·sec) for 10^3 hours, ^{238}Pu (~60 μg), ^{242}Cm (0.4 μg), and ^{243}Cm (4×10^{-3} μg) were obtained from 1 mg of ^{241}Am. A program of long-term irradiation of ^{241}Am in JMTR (3×10^{14} n/cm^2·sec) is now underway. The other methods are nuclear explosion to produce ^{250}Cm, $^{251,254}Cf$, ^{255}Es, and ^{257}Fm, and irradiation with accelerated particles. Finally, αγn caves to handle the transplutonium elements are discussed briefly. (Japan)

Reactor Fuel Reprocessing

Refer also to abstracts 106, 1572, and 1959.

284 (AECL-4214) FUEL REPROCESSING WITH TERTIARY AMINE EXTRACTANTS. Part 2. A Manual of Analytical Methods. Dyck, R. W.; Boase, D. G. (Atomic Energy of Canada Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment). Jan 1973. 110p. Dep. NTIS (U. S. Sales Only) $7.50.

The recovery of plutonium from irradiated natural uranium using tertiary amine extractants is being investigated at the Whiteshell Nuclear Research Establishment for the reprocessing of Canadian power reactor fuels. The extraction behavior of plutonium and uranium into Alamine 336 in diethylbenzene was studied using simulated fuel solutions in the laboratory, and irradiated fuel in a miniature scale pilot plant. A wide variety of analytical methods developed to facilitate the evaluation of such process parameters as plutonium and uranium distribution coefficients, fission product decontamination and the efficiency of plutonium recovery is described. The methods used to determine uranium, plutonium, americium, fission products, amines and others, are discussed and the laboratory procedures are given. (auth)

285 (JUL-898-ZE) MODEL OF A DESIGN FOR POSITIONING SPHERICAL FUEL ELEMENTS IN A BASE WITH NONCONTACT FLUID GAUGING. Hotfilter, J.; Meissen, R. (Kernforschungsanlage, Juelich (West Germany). Zentrallabor fuer Elektronik). Nov 1972. 19p. (In German). Dep. NTIS (U. S. Sales Only) $3.00.

The originally planned method for the reprocessing of fuel elements, containing a loose bedding of coated particles in the mechanical head end, required that the elements were opened by drilling through the same boring which had been closed with a pin. The boring of 3 mm diameter was marked by pushing the pin to about 2 mm below the surface. A model arrangement was produced in which the sphere was rotated in such a way that the boring could be gauged by a stationary sensor. After finding the boring, the motion of the sphere stopped; thus, the boring was in a definite position and work on the sphere could begin. The surface of the sphere was gauged with a noncontact fluid sensor. Two stepmotors served as drivers. They were controlled through an electrical hook-up which was built with TTL blocks. (tr-auth)

ENGINEERING

Energy Conversion

286 (LA-5202-MS) THERMODYNAMIC ANALYSIS OF MHW SPACE ELECTRIC POWER GENERATOR. Kent, R. A. (Los Alamos Scientific Lab., N. Mex.). Mar 1973. Contract W-7405-eng-36. 108p. Dep. NTIS $3.00.

A thermodynamic analysis has been made for the proposed Multihundred Watt (MHW) isotopic electric power heat source for space missions. The heat source consists of plutonium dioxide fuel spheres encapsulated in welded iridium shells that in turn are surrounded by graphite ablation shields. Published data for the component systems Pu-O, Pu-Ir, Pu-C, Ir-O, and Ir-C have been reviewed and employed to calculate the thermochemical behavior during mission lifetime. (auth)

287 (RCA-3582-43) COMPACT THERMOELECTRIC CONVERTER DEVELOPMENT PROGRAM: PHASE IIB. Final Report, January 1-December 31, 1967. (Radio Corp. of America, Harrison, N. J.). 2 Jan 1968. Contract AT(30-1)-3582. 325p. (TH-349-71-647). Dep. NTIS $18.25.

Declassified 13 Apr 1973.

The development of a prototype module design of a thermoelectric generator is described in detail. This thermoelectric generator with silicon-germanium elements is usable with both radioisotope and reactor heat sources, is compact, rugged, versatile, can operate for long time periods, and is suitable for operation in a space environment. (LCL)

288 SOLAR ENERGY: ITS CONVERSION AND UTILIZATION. Farber, E. A. (Univ. of Florida, Gainesville). Solar Energy; 14: No. 3, 243-252(Feb 1973).

A brief summary is presented of solar energy research, comments on the need for continuing these studies, and the activities of the University of Florida Solar Energy Laboratory. These activities include converting solar energy to more practical forms of power and devising ways to produce it in the fewest possible steps by the simplest means. The devices developed are used in the University of Florida Solar House with its Solar-Electric Car and solar-heated swimming pool. (auth)

289 COST OF HOUSE HEATING WITH SOLAR ENERGY. Loef, G. O. G. (Colorado State Univ., Fort Collins); Tybout, R. A. Solar Energy; 14: No. 3, 253-278(Feb 1973).

A rigorous analysis was made of projected solar heating costs in eight U. S. cities, and the heating system design in each location was optimized. The analysis involved the use of a high-speed computer and approximately 400,000 hourly observations in eight cities of radiation, temperature, wind, solar altitude, cloud cover, and humidity. Equations for performance of flat plate solar collectors and sensible heat storage systems were developed and programmed with the above weather variables and with eight design parameters comprising house size, collector size, storage size, collector tilt, number of transparent surfaces in collector, hot water demand, insulation on storage unit, and thermal capacity of collector. Capital and operating costs were quantitatively related to heating system design parameters, and the values of all design variables which yielded lowest annual heating cost in each city were then selected. The findings are presented in the form of two tables and ten graphs, showing heating costs as functions of various design and location factors. The relative importance of each factor is discussed, and the overall costs of solar heating are compared with the costs of conventional heat supply in each location. The method for designing the least-cost combination of solar and conventional heat supplies is also shown, and an example of the use of the method is presented. (auth)

290 COMMERCIAL SOLAR CELL ARRAY DESIGN. Ralph, E. L. (Heliotek Division of Textron, Sylmar, CA). Solar Energy; 14: No. 3, 279-286(Feb 1973).

Solar cell arrays designed for space use are not suitable for terrestrial electric power generation applications. The environment on Earth is much different and the commercial price range for these applications is much lower than that for space applications. Solar cell array designs that provide protection from the terrestrial environment and at the same time bring the array price down from about $100 per watt (space design price) to about $25 per W are described. Optical efficiency of the concentrator design is 76%. The thermal characteristics of the arrays were measured and electrical performance data is presented. (auth)

291 SEA PLANT: A SOURCE OF POWER, WATER, AND FOOD WITHOUT POLLUTION. Anderson, J. H. Solar Energy; 14: No. 3, 287-300(Feb 1973).

The idea of sea thermal power is expanded to show how it can be used to produce fresh water as a by-product or a major product from the plant. Limitless quantities of fresh water can be produced at a cost of less than five cents per thousand gallons. The warm water leaving the boilers of the power plant is deaerated, then boiled under vacuum conditions to produce steam. The heat to evaporate steam comes from the water and lowers its temperature a few degrees. The steam is condensed in condensers cooled by the cold water discharged from the power plant condensers. The power required for pumping the water and for deaeration is produced by the sea thermal power plant. More than a billion gallons of water per day can be produced by a power plant of 100 MW capacity. Since the condenser water from the deep ocean is warmed by the power plant and desalting plant, it will remain near the surface, and can therefore provide food for fish. We estimate that a 100 MW power plant can supply enough nutrient-rich water to grow up to seven million kg of fish per y. (auth)

292 DESIGN AND PERFORMANCE OF A LARGE-SIZE SOLAR WATER HEATER. Garg, H. P. (Central Building Research Inst., Roorkee, India). Solar Energy; 14: No. 3, 303-312(Feb 1973).

The design details of a solar water heater suitable for the large, intermittent demands for hot water by hospitals and hostels are reported. It employs a flat-plate collector consisting of a wire-tied aluminium fin of 28 gage with galvanized iron pipes of 19 mm dia spaced at 10 cm centers. The unit is adjusted to give maximum efficiency per unit cost under Indian conditions. Various arrangements for connecting the collectors, such as cascade, series, series parallel, and true parallel, were experimentally studied. This revealed that for a solar water heating system having a large number of absorber banks, the true parallel arrangement yields maximum efficiency and economy. The system is fully-automatic and heats 600 liters of water up to 55°C in winter months at Roorkee. Heat losses at night may be compensated for, if required, by an auxiliary electric heater provided in the storage tank and controlled by a low-cost radiation-sensing device. A simple electric circuit controls the tank mean temperature of water in the storage tank. Required collector areas based on meteorological observations for various water capacities and water temperatures are given for several Indian cities. (auth)

293 SOLAR STRIP CONCENTRATOR. Szulmayer, W. (Commonwealth Scientific and Industrial Research Organization, North Ryde, Australia). Solar Energy; 14: No. 3, 327-335(Feb 1973).

A solar concentrator, capable of focusing solar heat on a linear target viz. a rod or a water pipe, consists of a transparent extruded plastic strip 6 in. wide and 0.040 in. thick. A pattern of prismatic parallel grooves and ridges produces the required beam refraction. Temperatures between 140 to 290°F were produced in exploratory heating experiments which indicate the possibility of using the strips for water heating, steam production, regeneration of dessicants (silica gel), as well as thermoelectric power generation. Some aspects of design, production, and operation of the strips are discussed. (auth)

294 POSSIBLE INSTABILITY IN THE DUCT OF AN MHD GENERATOR. Nedospasov, A. V.; Khait, V. D. High Temp. (USSR) (Engl. Transl.); 10: No. 4, 796-797(1972).

Translated from Teplofiz. Vys. Temp.; 10: No. 4, 887-889 (1972).

The behavior of small perturbations in magnetohydrodynamic flow in an MHD generator duct are discussed using the analogy of the behavior of perturbations in an ordinary liquid under free convection in a gravitional field. A system of linearized equations is developed for describing the behavior of such perturbations in a steady state flow of an inviscid, nonheat-conducting, electrically conducting medium in a uniform cross section planar rectangular duct in a constant magnetic field. (LCL)

295 INDUCTION-TYPE MAGNETOHYDRODYNAMIC GENERATOR WORKING ON THE COMBUSTION PRODUCTS OF AN ORGANIC FUEL. Zaklaz'minskii, L. A.; Krylova, L. M. High Temp. (USSR) (Engl. Transl.); 10: No. 4, 772-781(1972).

Translated from Teplofiz. Vys. Temp.; 10: No. 4, 863-873(1972).

The article gives the scheme of an induction-type magnetohydrodynamic generator, working on the combustion products of an organic fuel, with alternating layers of hot and cold working gases. The hot layers are obtained by the development, in a T layer, of a small perturbation of the electrical conductivity, applied to the steady-state flow of the combustion products at the inlet to the magnetohydrodynamic channel of the generator. It

is shown that, in a high-power generator ($N \geq 10^6$ kW), it is possible to obtain high values of the internal efficiency ($\eta_T \cong 0.6 - 0.7$) and of the power coefficient ($\cos \varphi \cong 0.2 - 0.5$). (auth)

296 CHARACTERISTICS OF THERMIONIC CONVERTER WITH CESIUM–BARIUM FILLING AT HIGH ANODE TEMPERATURE. Osadchii, V. A.; Piskunkov, A. F.; Szhenov, Yu. K. High Temp. (USSR) (Engl. Transl.); 10: No. 4, 664-668(1972).

Translated from Teplofiz. Vys. Temp.; 10: No. 4, 738-743(1972).

An experimental study is made of thermionic converters filled with a mixture of cesium and barium vapors in a regime close to gaskinetic. The investigations are carried out over a much wider range of electrode temperatures than previously and the anode temperature is optimized. High output powers (~24 W/cm²) are attained. Some conclusions are drawn concerning the power capabilities of such converters. Theoretical curves of the current-voltage characteristics of the converter are presented and the results of a theoretical calculation of the plasma parameters given. (auth)

297 FUNDAMENTAL PHENOMENON OF MAGNETOHYDRODYNAMIC ENERGY CONVERSION. Csorsz, E. Acta Tech. Acad. Sci. Hung.; 65: No. 1-2, 43-55(1969).

The fundamental phenomenon of the direct current MHD generator using a gas plasma as a working fluid is discussed. By way of introduction, the interaction between the components of the working fluid in the process of energy conversion is interpreted and conditions for the validity of analysis are given. The analysis is based on the relationships of plasma equilibrium. The density of the gas dynamic forces acting on various plasma components is presented in a novel way by the product of partial pressure gradients and momentum transfer probabilities. As a result, some basic relationships for the power design of generators are derived. (auth)

298 DETERMINATION OF THE RADIAL THERMAL CONDUCTIVITY OF SEVERAL LAYER CYLINDRICAL TUBES FOR THERMIONIC CONVERTERS. Fiebelmann, P. (Joint Nuclear Research Center Ispra, Italy). Forsch. Ingenieurw.; 38: No. 5, 133-138(1972). (In German).

A method to determine the radial thermal conductivity of cylindrical tubes using thermocouples is given. The disturbance of the temperature field due to the thermocouples has to be taken into account when evaluating the measurements. The setting up of the measuring equipment is described and the usefulness of this method in the technically important range of 400 to 750°C is demonstrated using steel and niobium alloy (Nb–1 Zr) samples. With this method, several hot-pressed layered tubes were measured. (GF)

299 THERMOELECTRIC RADIOISOTOPE BATTERY FOR THE POWER SUPPLY OF A CARDIAC PACEMAKER. Renner, T.; Rittmayer, G.; Falkenberg, D.; Grubmueller, G.; Waligora, D. (Siemens AG, Erlangen, Ger.). Siemens Forsch.-Entwicklungsber.; 1: No. 4, 355-361(1972). (In German).

The technical concept, the method of preparation, and the operational properties of a thermoelectric radioisotope battery for supplying power to cardiac pacemakers are described. ^{238}Pu is used as the radiation source. (GF)

300 INCORE THERMIONIC REACTORS. General Principles of Thermionic Energy Conversion: Present State of the Art. Pruschek, R. Energie; 24: No. 12, 302-310(1972). (In German).

An interpretation of the principles of thermionic energy conversion is given in terms of thermodynamics. A comparative thermodynamic process is presented and calculated in detail, taking into account all idealized changes of state experienced by the working medium during a complete cycle. The purpose of this presentation is to provide a correlation between the thermodynamics of thermal engines and the field of work of electrical engineers and physicists. The loss factors in a true converter (cesium converter) is presented and the extent that they reduce the theoretically achievable efficiency is shown. This is followed by a short survey of the present state of development of cesium converters. The design of Incore Thermionic Reactors is discussed and the problems arising in the development of reactors of this type are summarized as well as the present status of the German Incore Thermionic Reactor Project (ITR project). (GF)

301 DISCHARGE CHARACTERISTICS IN CESIUM-SEEDED ARGON. Evans, N. A. (Univ. of Pennsylvania, Philadelphia). AIAA (Amer. Inst. Aeronaut. Astronaut.) J.; 11: No. 5, 683-688 (May 1973).

As part of a program investigating nonequilibrium MHD power generation, experiments were performed to study discharge characteristics in a cesium-seeded argon blowdown facility with a maximum capability in gas total temperature of 1500°K, Mach number M = 0.6 and applied magnetic field B = 22,500 gauss. The results show that an ionization instability can occur as the result of a slow ionization rate in a convective flowfield, and does not necessarily depend on the presence of a magnetic field. Discharge holding devices were fully capable of controlling the instability up to M = 0.6 with B = 0, but some effectiveness was lost with increasing B due to a dependence of the final channel nonequilibrium conductivity on the magnetic field and the electrode geometry without the need to consider nonuniform conductivity effects arising from discharge streamers or striations. In addition, measurements showed that an increasing magnetic field produced an increase in the electron density recombination rate; the plasma breakdown voltage; and the plasma dissipation rate with respect to conductivity. There was also evidence of significant electron density relaxation during preionization. (auth)

302 STUDY OF VARIOUS METHODS OF TRAPPING AN IONIZING ADDITIVE IN THE U-02 EXPERIMENTAL MAGNETOHYDRODYNAMIC GENERATOR. Apukhtina, E. G.; Bordacheva, V. V.; Val'dberg, A. Yu.; Vikhrov, E. A.; Kurkin, V. P.; Mostinskii, I. L.; Nekhoroshev, R. S.; Sorokin, G. S.; Fedorova, Zh. S. pp 202-219 of Magnitogidrodinam. metod polucheniya elektroenergii. Vypusk 3. Moscow; Energiya (1972). (In Russian)

The requirements of additive injection systems are formulated. Methods of trapping an ionizing additive and the structural execution are described. The operating experience using additive injection systems in experimental magnetohydrodynamic generators is described, and results are presented from studies of the efficiency of trapping them with submicron K_2CO_3 dust from a flow of combustion products. A study was made of the advantages and disadvantages of each of the systems. (JPRS)

303 MINIATURIZED ELECTRIC SOURCE. Ducommun, G. (to Baumgartner Freres SA). Canadian Patent 902,810. 13 Jun 1972. Priority date 7 May 1969, Switzerland.

A miniature isotopic power source, suitable for an electric watch or other small instrument is described. A thin layer of lithium tritide, or of a tritium compound of Zr or Y, is deposited on a metal (e.g., Cu) disc, which is insulated from the metallic casing of the battery by a thin plastic film. A lead passes out from the copper disc, and is insulated from the casing. Beta rays emitted from the tritium are collected by the casing. The device has a capacity of about 1 nF, and the β rays are emitted at an initial energy of 18 keV. The battery is suitable for providing intermittent small pulses of current. (CA)

304 STIRLING CYCLE RELAXATION MOTOR FOR A TRANSPLANTABLE ARTIFICIAL HEART. Lavigne, P. (to Commissariat a l'Energie Atomique). French Patent 2,122,366. 1 Sep 1972. Filed date 22 Jan 1971. 18p. (In French).

This transplantable relaxation type artificial heart using an α particle energy source is provided with a pumping subassembly consisting of cardiac modules, a pump which activates these modules, and a motor integrated into the mechanism permitting the transfer of energy by a relaxation process. A Stirling cycle-type motor is used. (FR)

305 CRITICAL CATHODE POTENTIAL DROP AND CURRENT DENSITY AT THE ARC TRANSITION IN MHD POWER GENERATORS. Numano, M. (Kyoto Univ.). Plasma Phys.; 15: No. 4, 311-316(Apr 1973).

A theoretical investigation on the critical cathode potential drop at the arc transition was carried out by applying the stability condition of the thermal boundary layer to a one-dimensional model. The thermal and electrical conductivities of the gas were considered as functions of temperature. The general formulas for the critical cathode fall and current density were obtained, and were applied to a case which is often encountered in MHD power generators. It was found that the inverse of the logarithmic mean of the resistivities of the working gas at the temperatures of the cathode surface and of the main stream should be used as the electrical conductivity. (auth)

306 THERMODYNAMIC PROPERTIES OF LIQUID METAL MHD POWER-CYCLES. Bayer, Z. Pr. Inst. Masz. Przeply.; No. 54/55, 47-57(1971).

The results of calculations related to liquid metal multistage MHD cycles are discussed. The properties of liquid metals are described by six constants e.g., specific heat, specific volume of the liquid phase, constants describing the dependence of molar entropy of vaporization on pressure, and constants showing the dependence of temperature and saturation pressure. Four metals are considered: Li, Na, K, and Hg. Velocity after mixing was determined by assuming the conservation of energy for a constant cross section channel. Friction and mixing losses are considered. Results of the calculations are shown for the thermal efficiency as a function of temperature, metal mixture, and number of cycles. The influence of number of stages, mixing efficiency and characteristic parameters on the efficiency are also shown. Conclusions

are that single fluid systems are not practical due to low efficiency. Li–K system seems to be the easiest to use even though others have higher efficiency. It is indicated that the dependence of the thermal efficiency on the characteristic parameters of the fluid decrease rapidly with the reversibility of the cycle. (App. Mech. Rev.)

307 PRESENT STATE AND PROSPECTS OF DIRECT ENERGY CONVERSION. Part 1. Justi, E. W. (Technische Univ., Brunswick). Phys. Bl.; 29: No. 1, 20-33(1973). (In German).

Considering the five basic types of energy, namely mechanical, thermal, optical, electrical, and chemical, 25 different ways of direct energy conversion appear to be possible. The present paper discusses the most important methods such as MHD conversion, thermoelectric conversion by the Seebeck effect, cooling and heating by the Peltier effect, and photoelectric conversion. (GF)

Facilities and Equipment

Refer also to abstracts 765, 766, and 1617.

308 (INP-813) LABORATORY APPARATUS FOR THE PREPARATION OF ALLOYS AND INTERMETALLIC COMPOUNDS. Soltys, J.; Rzany, H.; Makar, R. (Institute of Nuclear Physics, Krakow (Poland)). Nov 1972. 17p. (In Polish). Dep. NTIS (U. S. Sales Only) $3.00.

The construction of the basic types of resistance furnaces with charging, temperature control, and stabilizing equipment for the preparation of intermetallic compounds and alloys are described. The apparatus has good parameters, is easily operated, and is simple in construction. Samples can be roasted in an air, vacuum, or protective gas environment, and hardened in water, liquid nitrogen, or oil. (auth)

309 (LMEC-TDR-73-2) METALLURGICAL ANALYSIS OF FAILED SCTI THERMOWELL NO. TR-104-62E. King, G. A. (Atomics International, Canoga Park, Calif. Liquid Metal Engineering Center). 15 Jan 1973. 76p. AT $5.45.

A sodium fire occurred at the Sodium Components Test Installation (SCTI) on August 5, 1972 because of sodium leakage through a thermowell located in the Primary Sodium Inlet to the SCTI-IHX. The thermowell failed with the system operating at approximately 32% power level with sodium flowing at ~1800 gpm at a temperature of 850°F. The failed thermowell (TR-104-62E) was one of two located on an 8-in. by 10-in. stainless steel pipe reducer downstream of, and adjacent to, an 8-in. butterfly valve (FRC-100V1) in the IHX Primary Sodium Inlet. Metallurgical analysis revealed that the failure was a result of high-cycle, low-amplitude fatigue at the transition radius between the thermowell stem and the thermowell support. Failure was attributed to vibrational loading conditions which were excessive for the part configuration. (auth)

310 (NYO-4117-9) DEVELOPMENT OF HIGH TEMPERATURE ROLLING BEARINGS FOR OPERATION IN LIQUID SODIUM. Interim Final Report No. 1, June 15, 1970–June 30, 1972. Jamison, W. E. (SKF Industries, Inc., King of Prussia, Pa. Research Lab.). 1972. Contract AT(11-1)-3061. 161p. Dep. NTIS $7.60.

A program is underway to develop rolling bearings for operation in a liquid sodium environment in the temperature range 800 to 1200°F. This work, in support of the Liquid Metal Fast Breeder Reactor (LMFBR) development program, has identified typical applications for rolling bearings in liquid sodium, and has established preliminary materials and design requirements and manufacturing procedures for these rolling bearings. A test facility has been established which is capable of testing rolling bearings in liquid sodium at temperatures up to 1200°F, at speeds up to 1500 rpm and under thrust loads up to 1000 pounds. Materials evaluation specimens, having the configuration of two flat washers separated by three cylindrical rollers whose axes intersect the flat washer axes, have been made from Rex 49 and NM100 tool steels and from Udimet 700 nickel base superalloy. A test series with the Rex 49 specimens was run. Ball Bearings of NM100 steel conforming to 7306 size envelope dimensions have been manufactured and a test series is underway. The results of both test series support the feasibility of utilizing rolling bearings as efficient shaft support systems in high-temperature liquid sodium, at least when O_2 contamination is of the order of 50 ppM, temperature is 800°F and load and speed are moderate. A new test rig is being built which, when inserted into a high-purity sodium loop elsewhere, will test the bearings in prototypic sodium to confirm these findings. Later generation test bearing parts are being made and tests under progressively more severe conditions continue. (auth)

311 (ORNL-TM-4098) ELBOW: A FORTRAN PROGRAM FOR THE CALCULATION OF STRESSES, STRESS INDICES, AND FLEXIBILITY FACTORS FOR ELBOWS AND CURVED PIPE. Dodge, W. G.; Moore, S. E. (Oak Ridge National Lab., Tenn.). Apr 1973. Contract W-7405-eng-26. 38p. Dep. NTIS $4.00.

A computer program is described for calculating the stresses, stress indices, and flexibility factors for in-plane and out-of-plane bending of elbows and curved pipe subjected to internal pressure. The results are obtained using a series solution as discussed by the authors in a separate report. Included is a listing of the computer program, a description of the input data, and an example of the output. (auth)

312 (RD/B/N-2432) BERGEN: AN AUTOMATIC FINITE ELEMENT MESH GENERATION PROGRAM FOR ARBITRARY STRUCTURES. Neale, B. K. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Oct 1972. 57p. Dep. NTIS (U. S. Sales Only) $5.00.

The BERGEN program was devised for analysis of the stresses associated with complex engineering structures associated with nuclear plant design. An important stage in using the finite element method is the representation of a structure in element form. BERGEN enables both two and three dimensional structures to be discretised into elements with minimum effort. The structure is divided into quadrilateral macroblocks for two-dimensional problems and hexahedral macroblocks for three-dimensional problems. The inclusion of a facility to automatically connect these macroblocks together provides a powerful method for the generation of complete meshes over complex engineering structures. At present, a macroblock can consist of a uniform or non-uniform mesh of elements of the type EP6, EP8, EP12, EP16, EZ24, EZ60, EZ96, and FS12. Depending on the element type, the sides or edges of a macroblock can vary in a linear, quadratic or cubic manner. In use BERGEN has shown considerable savings in time and cost over existing mesh generation programs. (auth)

313 (RT/ING-(72)16) DESCRIPTION OF THE IBM-360 VERSION OF THE FINITE ELEMENTS COMPUTER PROGRAM SAFE 3D. Massini, G.; Pepino, A.; Serchia, L.; Zaccarelli, P. (Comitato Nazionale Per l'Energia Nucleare, Rome (Italy)). 20 Jul 1972. 84p. (In Italian). Dep. NTIS (U. S. Sales Only) $6.25.

The IBM-360 version of the finite element computer program SAFE-3D and its use for the three-dimensional stress analysis of structures are described. The results obtained for three different problems employing this program are compared with the results respectively of a photoelastic analysis; the finite difference method; and the finite element three-dimensional program AMSA-7 FIAT. (auth)

314 CONCERNING STUDIES OF HEAT-PIPE CHARACTERISTICS. Shevchuk, E. N.; Stambrovskii, V. D.; Kurikhin, V. I.; Bogdanov, V. V. Heat Transfer - Sov. Res.; 5: No. 1, 164-168 (1973).

Problems are discussed arising in designing and constructing heat pipes, as well as in planning experiments with heat pipes. The design of a laboratory facility for the study of heat pipe characteristics is discussed. (auth)

315 DEVELOPMENT OF THE STEAM TURBINE CONSTRUCTION FOR NUCLEAR APPLICATION IN THE TURBINE FACTORY AT CHARKOW. Savvin, V. N.; Kossjak, J. F.; Pansi, B. M.; Linecki, S. M.; Pankov, I. I.; Tomkov, J. P.; German, S. O. Arch. Energiewirt.; 26: No. 7, 332-345(1972). (In German).

A description of the essential features of saturated steam turbines is followed by a discussion of the heat cycle and the design of various types of turbines, illustrated by many technical data. Moreover, the following problems are discussed: moisture separation, erosion protection, steam control, reliability and materials used. (GF)

316 TWO-DIMENSIONAL FINITE ELEMENT COMPUTER CODES FOR STRESS ANALYSIS AND FIELD PROBLEMS. Brusa, L.; Ciacci, R.; Ticozzi, C. (CISE, Milan). Energ. Nucl. (Milan); 20: No. 3, 154-170(Mar 1973).

Two computer codes developed at CISE and based on the finite element method are presented. Such codes have been set up for structural analysis and thermal steady-state field problems for two-dimensional structures. For both codes a detailed description of the main features is given. It is shown that code performances are very satisfactory as far as result reliability and running time are concerned. (auth)

317 CONVERGENCE OF A MIXED FINITE ELEMENT SCHEME FOR PLATE BENDING. Kikuchi, F.; Ando, Y. (Tokyo Univ.). Nucl. Eng. Des.; 24: No. 3, 357-373(1973).

The convergence of a mixed finite element scheme for plate bending, previously proposed by the present authors, is discussed on the basis of functional analysis. First, the outline of the formulation is presented with some mathematical preliminaries. Then, several kinds of energy inequalities are established to assure the

stability of the approximate solution. Thus, the rate of convergence may be obtained by the evaluation of the degrees of the completeness and consistency of the employed shape functions. Some remarks are also given with respect to the extension of the method to initial value problems. (auth)

318 TRANSIENT THERMAL STRESSES ON A HOLLOW CIRCULAR DISK UNDER AN INSTANTANEOUS POINT HEAT SOURCE. *Takeuti, Y.; Noda, N. (Shizuoka Univ., Hamamatsu,* Japan). Nucl. Eng. Des.; 24: No. 3, 440-450(1973).

A treatment of the asymmetrical transient thermoelastic problem for a hollow circular disk under an instantaneous point heat source at an arbitrary point on the disk is presented. The derivation of temperature and thermal stress components is outlined. The analysis is developed by the technique of Laplace transform. (auth)

319 FREE VIBRATIONS OF SHELLS OF REVOLUTION WITH VARIABLE THICKNESS. Stoneking, J. E. (Clarkson *Coll. of Tech., Potsdam, NY). Nucl. Eng. Des.; 24; No. 3, 314-*321(1973).

The partition method is used to formulate a set of equations which are used to calculate the natural frequencies and mode shapes of shells of revolution with variable thickness. Several examples are given for the cylinder and the hyperboloidal cooling tower. Results indicate that moderate variations in shell thickness do not appreciably affect the natural frequencies, but may significantly affect mode shapes. (auth)

320 COMPUTERIZED 3-D DESIGN FOR NUCLEAR ENGINEERING. Laing, P. R. Eng. Graphics; 12: No. 7, 4p. (Jul 1972).

Complex structures usually are designed using scale models. A computer system for analyzing plans three-dimensionally to better visualize the design process and prevent interferences is described. (auth)

321 METHOD FOR WELDING A METALLIC FILTER ONTO A NONPOROUS METALLIC ELEMENT. Defresne, M.; Massignon, D.; Gilles, P.; Eudier, M. (to Commissariat a l'Energie Atomique), *French Patent 2,125,670, 29 Sep 1972. Filed date 16 Feb* 1971. 5p. (In French).

A procedure for welding a metallic tubular filter and a nonporous metallic element (a tube) is presented. The metallic filter and the nonporous metallic element are joined using a near eutectic nickel-phosphorus composition. They are heated to a temperature lying between the melting point of the metallic composition and the melting point of the most easily molten of the metals in either the filter or the nonporous element. The case of a tubular Ni filter welded to a Ni tube is given as an example. This procedure can be used to position thin tubular filters for separating uranium isotopes by gaseous diffusion. (FR)

Heat Transfer and Fluid Flow

Refer also to abstracts 298, 314, 804, and 1634.

322 (AAEC/TM-621) COMPARISON BETWEEN THE COMPUTER CODES OWEN AND TOSCLE IN A CALCULATION OF TWO-PHASE FLOW STABILITY. Spinks, N. (Australian Atomic Energy Commission Research Establishment, Lucas *Heights). Aug 1972. 24p. Dep. NTIS (U. S. Sales Only) $3.25.*

Two computer codes using quite different techniques for solving the same equations are applied to a common flow-stability problem. The TOSCLE code uses closed-form solutions of the mass, energy and momentum conservation equations while the OWEN code uses finite elements in both space and time. The problem selected is a model of a natural circulation loop. If the number of finite elements were unlimited the two codes should give the same answer. However the OWEN solution is found to be more sensitive than expected to the imposed two-dimensional mesh and some discrepancy exists even in the best OWEN solution. An optimum spatial mesh distribution is sought for OWEN and this is found to be highly non-uniform. In particular a very fine mesh is required near the bulk-boiling boundary. This requirement is attributed to the omission of a special boiling-boundary mesh point in OWEN. Spurious flow oscillations occur when the boiling boundary crosses a fixed spatial mesh point. (auth)

323 (AERE-M-2312) RECENT DEVELOPMENTS IN THE STUDY OF CRITICAL HEAT FLUX AND POST DRYOUT HEAT TRANSFER. Collier, J. G. (Atomic Energy Research Establishment, Harwell (England)). May 1970. 30p. Dep. NTIS (U. S. Sales Only) $3.50.

A review of recent publications concerned with the study of critical heat flux and post dryout heat transfer in boiling systems has been carried out. Emphasis has been placed on the papers presented to the European Two-phase Flow Group Meeting in Karlsruhe 1969. Among the topics discussed are critical heat flux in vertical round tubes, and the mechanism of dryout in vertical tubes, critical heat flux in annuli and rod clusters, and modeling of forced convection boiling systems, turbulent mixing between subchannels in rod bundles, methods of improving the critical heat flux and heat transfer in once-through steam generators. Where appropriate recommendations for further work have been made. This review is aimed at providing an introduction to the papers to be presented at the 1970 European Two-phase Flow Group Meeting in Milan. (auth)

324 (AREAEE-154) EXPERIMENTAL LOOP FOR CONDENSATION MEASUREMENTS ON HORIZONTAL TUBE BUNDLE. *El-Fouly, M. F.; Rizk, A. M.; Darwish, M. A.; Ali, S. E. (Atomic* Energy Establishment, Cairo (Egypt). Reactors Dept.). 1972. 24p. Dep. NTIS (U. S. Sales Only) $3.25.

Experimental apparatus designed and fabricated for studies of laminar film condensation of saturated steam on the external surface of a horizontal tube bundle in cross flow is described. Each component of the experimental loop is discussed. The experiments should establish a reliable basis for predicting the average heat transfer coefficient for all rows of tubes with laminar flow of the film condensate. (LCL)

325 (ORNL-TM-4079) FORCED-CONVECTION HEAT-TRANSFER MEASUREMENTS WITH A MOLTEN FLUORIDE SALT MIXTURE FLOWING IN A SMOOTH TUBE. Cooke, J. W.; Cox, B. *(Oak Ridge National Lab., Tenn.), Mar 1973, Contract W-7405-*eng-26. 59p. Dep. NTIS $5.00.

Heat-transfer coefficients were determined experimentally for a proposed MSBR fuel salt ($LiF-BeF_2-ThF_4-UF_4$; 67.5–20.0–12.0–0.5 mole %) flowing by forced convection through a 0.18-in.-ID horizontal, circular tube for the following range of variables: Reynolds modulus 400 to 30,600, Prandtl modulus 4 to 14, average fluid temperature (°F) 1050 to 1550, and heat flux (Btu/hr/ft²) 22,000 to 560,000. Within these ranges, the heat-transfer coefficient was found to vary from 320 up to 6900 Btu/h/ft²/°F (Nusselt modulus of 6.5 to 138). Correlations of the experimental data resulted in the equations: $N_{Nu} = 1.89\,[N_{Re}\,N_{Pr}\,(D/L)]^{0.33}\,(\mu/\mu_s)^{0.14}$, with an average absolute deviation of 6.6% for $N_{Re} < 1000$; $N_{Nu} = 0.107\,(N_{Re}^{0.9} - 135)\,N_{Pr}^{0.4}\,(\mu/\mu_s)^{0.14}$, with an average absolute deviation of 4.1% for $3500 < N_{Re} < 12{,}000$; and $N_{Nu} = 0.0234\,N_{Re}^{0.8}N_{Pr}^{0.4}\,(\mu/\mu_s)^{0.14}$, with an average absolute deviation of 6.2% for $N_{Re} > 12{,}000$. (auth)

326 *(RT/ING-(72)19) ADVANCES IN HEAT TRANSFER.* (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 16 Oct 1972. 294p. Dep. NTIS (U. S. Sales Only) $16.75.

A collection of papers was selected to present an overall idea of the research work in the heat transfer field performed at the Laboratorio Tecnologie Reattori of the Centro Studi Nucleari, Casaccia (Rome), of the CNEN (National Committee for Nuclear Energy). The papers deal particularly with boiling heat transfer and two-phase flow. Post burnout has been particularly studied. Although relating to different problems, the various researches contribute to form a general picture of two-phase flow phenomenology. (auth)

327 THERMODYNAMIC ANOMALIES NEAR THE CRITICAL POINT OF STEAM. *Sengers, J. M. H. L.; Greer, S. C. (National* Bureau of Standards, Washington, DC). Int. J. Heat Mass Transfer; 15: No. 10, 1865-1886(Oct 1972).

Ideas about the character of critical anomalies obtained from the lattice gas model are tested on the thermodynamic properties of steam, using methods developed for nonpolar gases. The critical anomalies in steam are shown to be nonclassical and very similar to those of simple gases. Specifically, the exponents obtained by power-law analysis of the coexistence curve, specific heat C_V and compressibility K_T are $\beta = 0.347 \pm 0.005$, $\alpha = 0.1 \pm 0.05$, $\gamma = 1.20 \pm 0.05$, implying $\delta = 4.45$. Since the critical point is thus a point of nonanalyticity in the thermodynamic behavior, the scaled equation of state may be an appropriate means to describe the critical region. Some results of such a scaled analysis of the PVT data are presented and shown to be consistent with independently measured vapor pressure and specific heat data and with the exponents quoted. The best value obtained for the critical temperature by scaling is 373.9°C ± 0.05°. Values between 0.322 and 0.327 g/cm³ are obtained for the critical density depending on the property analyzed. It should be noted that an erratum correcting a number of the figures quoted is published in Int. J. Heat and Mass Transfer; 16: 225(Jan 1973). (UK)

328 TWELFTH NATIONAL HEAT TRANSFER CONFERENCE, TULSA, OKLAHOMA, AUGUST 15–18, 1971. Rosson, H. F. (Ed.) AIChE Symp. Ser.; 68: No. 118, 1-179(1972). (CONF-710822-).

From 12th national heat transfer conference; Tulsa, Oklahoma, USA (15 Aug 1971).

Nineteen papers were presented. A separate abstract was prepared for each of 8. The remaining 11 papers were not within the scope of NSA. (LCL)

For abstracts of individual papers see: 329–335 and 1634.

329 TWO-PHASE LIQUID–LIQUID FLOW IN PIPES. Soeoet, P. M.; Knudsen, J. G. (Oregon State Univ., Corvallis). AIChE Symp. Ser.; 68: No. 118, 38-44(1972).

From 12th national heat transfer conference; Tulsa, Oklahoma (15 Aug 1971).

Empirical and theoretical equations were derived for predicting pressure losses for two-phase liquid–liquid flow in pipes. The semi-empirical equations based on present data and work of several previous investigators are applicable to all flow regimes in either horizontal or downward vertical flow for the continuous phase in turbulent flow and for the discontinuous phase in either laminar or turbulent flow based on the phase flowing alone in the pipe. An empirical holdup correlation was also developed from some existing experimental data. The form of the holdup correlation was of the form derived by Bankoff and the coefficient correlated in a manner similar to that of Hughmark. Drop size distributions were obtained during flow and were found to have a slight effect on pressure loss but not of sufficient extent to affect the pressure loss correlations within the standard deviations obtained with the experimental data. (auth)

330 CHARACTERISTICS OF BOILING OUTSIDE LARGE-SCALE HORIZONTAL MULTITUBE BUNDLES. Palen, J. W.; Yarden, A.; Taborek, J. (Heat Transfer Research, Inc., Alhambra, CA). AIChE Symp. Ser.; 68: No. 118, 50-61(1972).

From 12th national heat transfer conference; Tulsa, Oklahoma (15 Aug 1971).

A summary is presented of a major research project in boiling outside tubular bundles. Data were obtained for 14 different commercial sized kettle reboilers under controlled conditions over a wide range of pressures and fluid properties. Firm conclusions were possible regarding the previously unknown effects of bundle geometry, pressure, mixture composition, and surface conditions, resulting in a systematic, data-backed procedure for performance estimation. Many additional unknowns remain, however, and potentially useful areas of further research are discussed. (auth)

331 TURBULENT MIXING BETWEEN ADJACENT CHANNELS FOR SINGLE-PHASE FLOW IN A SIMULATED ROD BUNDLE. Galbraith, K. P.; Knudsen, J. G. (Oregon State Univ., Corvallis). AIChE Symp. Ser.; 68: No. 118, 90-100(1972).

From 12th national heat transfer conference; Tulsa, Oklahoma (15 Aug 1971).

The turbulent interchange of matter between parallel adjacent sub-channels in a simulated rod bundle for single-phase flow was investigated to determine the effects of mass flow rate and rod spacing. The simulated rod bundle was made by placing six 1-in. diam. rods in a square-square array. The experimental technique involved initially tracing one side of the test section and measuring the exit dye concentration for the initially untraced section. This result, plus the subchannel mass flow rate, was then used in an analytical model to calculate the turbulent mixing rate. The investigation covered five rod spacings, i.e., 0.011, 0.028, 0.063, 0.127, and 0.228 in. and a range of mass flow rates that resulted in a Reynolds number range of 8×10^3 to 3×10^4 for water. The results were: the turbulent mixing between adjacent subchannels can be correlated with turbulent eddy diffusivities for duct flow; the turbulent mixing is a function of the rod spacing and subchannel Reynolds number and increases with increasing rod spacing and Reynolds number; although the results may be correlated with the subchannel Reynolds number, the flow conditions in the immediate vicinity of the rod spacing are important especially for the smallest rod spacing; and small pressure gradients between adjacent subchannels have a significant effect upon the mixing results. (auth)

332 APPLICATION OF STABILITY ANALYSIS FOR DESIGN OF NATURAL CIRCULATION BOILING SYSTEMS AND COMPARISON WITH EXPERIMENTAL DATA. Blumenkrantz, A.; Taborek, J. (Heat Transfer Research, Inc., Alhambra, CA). AIChE Symp. Ser.; 68: No. 118, 136-146(1972).

From 12th national heat transfer conference; Tulsa, Oklahoma (15 Aug 1971).

A computerized technique based on Bourê's density effect model was used in conjunction with steady state predictions for calculation of stability limit in natural circulation boiling systems. Comparison of model predictions with available experimental data for the systems methylethylketone, isopropyl alcohol, benzene, n-propanol, and water at various pressures showed good agreement. A parametric study covering effects of several geometrical magnitudes on stability threshold verified experimental trends. (auth)

333 STABILITY ANALYSIS OF FILM BOILING ON VERTICAL SURFACES AS A TWO-PHASE FLOW PROBLEM. Kao, H. S. (Babcock and Wilcox Co., Lynchburg, VA); Morgan, C. D.; Crawford, M.; Jones, J. B. AIChE Symp. Ser.; 68: No. 118, 147-155 (1972).

From 12th national heat transfer conference; Tulsa, Oklahoma (15 Aug 1971).

The stability of film boiling on vertical surfaces is analyzed by integrating the Orr–Sommerfeld equations for vapor and liquid phases that govern the flow stability. The results obtained are a family of neutral stability curves in the wave number-Reynolds number plane. As the liquid-to-vapor density ratio increases or the viscosity ratio decreases, the neutral stability curve shifts toward lower Reynolds number, indicating a destabilizing effect on the vapor film. Increasing the surface tension causes the neutral stability curve to shrink to a smaller range of wave numbers and to a larger critical Reynolds number, indicating a stabilizing effect. The critical Reynolds numbers and the critical heights obtained are small, indicating an early transition from laminar to turbulent film boiling; therefore, industrial applications of film boiling can be analyzed using turbulent flow only. (auth)

334 SCANNING ELECTRON MICROSCOPE SURFACE STUDY OF NUCLEATE POOL BOILING HEAT TRANSFER TO SATURATED LIQUID NITROGEN. Porchey, D. V.; Park, E. L. Jr.; Mayhan, K. G. (Univ. of Missouri, Rolla). AIChE Symp. Ser.; 68: No. 118, 162-171(1972).

From 12th national heat transfer conference; Tulsa, Oklahoma (15 Aug 1971).

This study constituted an examination of both nucleate boiling and maximum heat flux characteristics of liquid nitrogen boiling from characterized surfaces. Several textures of gold-plated copper surfaces were studied in addition to silver and silver oxide surfaces. All surfaces were examined with a scanning electron microscope (SEM). (auth)

335 GAS ACCELERATION EFFECTS IN FILM CONDENSATION. Verhoff, F. H.; Thiele, E. W. (Univ. of Notre Dame, IN). AIChE Symp. Ser.; 68: No. 118, 172-179(1972).

From 12th national heat transfer conference, Tulsa, Oklahoma (15 Aug 1971).

The acceleration occurring when slow moving vapors approach the condensing surface produces a fall in temperature. At high fluxes, as with liquid metals, this may be large enough to require consideration in such experiments. Formulas and charts are given to permit an estimate of the effect for film condensation. (auth)

Materials Testing

Refer also to abstracts 584, 840, 1604, and 1736.

336 (BNWL-SA-4576) FLAW DETECTION BY ACOUSTIC EMISSION. Hutton, P. H. (Battelle Pacific Northwest Labs., Richland, Wash.). 1972. 37p. (CONF-730113-1). Dep. NTIS.

From Oregon State University seminar; Corvallis, Oregon, USA (31 Jan 1973).

Research on the acoustic emission phenomenon is reviewed, methods for detecting acoustic emission are discussed, and uses of the acoustic emission testing method to detect flaw growth are described. Principle applications include the monitoring of pressure vessels for flaw growth during hydrostatic proof testing and while in service; fatigue crack growth monitoring of in-service materials; and surveillance of welds for flaw formation. It is concluded that acoustic emission technology has reached the point where it can be effectively applied to material characterization in the laboratory, detection and location of flaws during welding and proof testing, and continuous in-service monitoring. Conventional nondestructive testing must, however, be utilized to establish the size of a detected flaw. Significant development work remains to realize acoustic emission testing's full potential. (LCL)

337 (CEA-CONF-2217) PRESENT DAY METHODS OF TESTING OF SHIELDING AGAINST GAMMA RAYS. Fourcade-Cancelle, N.; Papot, L. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). [nd]. 20p. (In French). (CONF-721018-9). Dep. NTIS (U. S. Sales Only) $3.00.

From fourth international conference on reactor shielding; Paris, France (9 Oct 1972).

Shielding materials are well known. Their efficiencies, however, depend on the way they are used to construct shields. This efficiency is verified using ^{60}Co radioactive sources with activities up to 20,000 Ci. The most frequently used detectors are scintillation detectors and ionization chambers. Gammagraphy is used to establish the nature and form of the defects occurring in the

shielding. Corrections are made depending upon the dose rates measured. In this way, it is ensured that the shield has a normal homogeneity. Studies were conducted by the CEA in collaboration with the AIEA, and AFNOR, in order to define the acceptance criteria in view of the real consequences of such defects for the working personnel. (FR)

338 (REG/G-1-15(12-72)) TESTING OF REINFORCING BARS FOR CATEGORY I CONCRETE STRUCTURES. (Directorate of Regulatory Standards (AEC), Washington, D. C.). 28 Dec 1972. 2p. DRS, Washington, DC Free.

339 MEASURING PROJECTION WELD STRENGTH BY ACOUSTIC EMISSION. Schwenk, E. B.; Shearer, G. D. (Battelle Northwest, Richland, WA). Nondestr. Test.; 6: No. 1, 29-33(Feb 1973).

Data are presented that show the feasibility of non-destructively measuring resistance projection weld strength in Zircaloy-2 by measuring the acoustic emission count during the welding. The data were obtained by mounting one or two piezoelectric sensors on one electrode and conditioning and recording the resultant acoustic emissions on one or two high frequency digital counters. The acoustic emission appears to be generated primarily by the consolidation of the metal joint and the number of emissions appears to be a function of the weld zone size. (auth)

340 IMPROVEMENTS IN THE DETECTION OF FLAWS AND BLOCKAGES IN PIPES. Latham, F. G. (to United Kingdom Atomic Energy Authority). British Patent 1,302,028. 4 Jan 1973. 5p.

An acoustic method is described for the location of flaws and blockages in gas filled pipes in places where visual inspection is not feasible, such as pipes used for conducting gas samples from the core of a nuclear reactor to apparatus for detecting fission product content. It comprises the following steps: (1) generating an acoustic signal, at one end of the pipe, having a variable frequency, that can sweep over resonances of the gas column in the pipe; (2) detecting the occurrence of the resonances; (3) determining the average frequency spacing of the resonances; and (4) determining the location of the blockage by the formula $L = c/2\Delta$, where L is the distance of the block from the place of detection of the resonance, c is the velocity of sound in the gas, and Δ is the average frequency spacing of the resonances. The method may be applied to the location of more than one blockage. The necessary apparatus is also described. (UK)

341 ULTRASONIC TECHNIQUE FOR THE INSPECTION OF MAGNETIC AND EXPLOSIVE WELDS, USING A FACSIMILE RECORDING SYSTEM. Borloo, E. E. (Joint Nuclear Research Center, Ispra, Italy). Nondestr. Test.; 6: No. 1, 25-28(Feb 1973).

A technique is described that was developed in 1969 at the Euratom Joint Nuclear Research Center-Ispra in Italy to determine the weld-seam geometry of fuel element end plugs welded with the Magneweld process. A recording is made on a facsimile recorder to produce a developed image of the weld seam. A practical case is described where a magnification factor of 10 is used so that 10 mm on the ordinate of the recorder document corresponds to a 1 mm width of the weld seam. On the same document it is easy to determine the minimum and maximum values of the weld seam width with an accuracy of 0.1 mm and to locate the angular position. The measuring time is short and the record is immediately available and easy to interpret. (auth)

342 APPLICATION OF ION BEAMS, ELECTRON BEAMS, AND X RAYS IN MODERN MATERIAL TESTING. Christian, H.; Woitscheck, A. (Allianz-Zentrum-Technik, Ismaning, Ger.). Maschinenschaden; 45: No. 4, 151-159(1972). (In German).

The basic properties and the production of high-energy radiations are illustrated and the fields of application are discussed. The following investigation methods are reviewed: x-ray fluorescence analysis, x-ray crystal analysis, electron microprobe analysis, Auger analysis, scanning electron microscopy, electron diffraction, and ion microscopy. The range of application of these methods is indicated and their limits are discussed. The practical application is presented by giving some examples especially from the field of damage analysis. (GF)

Nuclear Explosions

Refer also to abstracts 390, 391, 433, and 944.

343 (FOA-4-4474-A-1) MAXIMUM LIKELIHOOD LINEAR FITTING WHEN BOTH VARIABLES HAVE NORMAL AND CORRELATED ERRORS. Ericsson, U. (Forsvarets Forskningsanstalt, Stockholm (Sweden)). Sep 1971. 22p. Dep. NTIS (U. S. Sales Only) $3.25.

This study was prompted by a need for a practical numeric method for fitting a straight line to pairs of seismological magnitudes, which are afflicted with considerable variations and measurement errors in both members of the pairs. The magnitudes are considered to be linear functions of an event generating parameter plus normally distributed errors. The distributions are assumed to be correlated between magnitudes and independent of the event parameter. Maximum likelihood fitting is then found to involve point adjustments along likelihood ellipse diameters conjugate to the fitted line. The analytical solution requires input of numerical values for the correlation coefficients and for the ratio between the standard deviations of the errors, their estimation in practice is briefly discussed. The computer calculated solution gives maximum likelihood estimates of the slope and the intercept of the fitted line, of their standard deviations, of the standard deviations of the errors, and of the undisturbed points on the fitted line. An example demonstrates the influence of the chosen standard deviation ratio on the solution and also how maximum likelihood fitting to seismic data can be used for the indirect determination of the relationships between surface wave magnitudes and event energy. Finally it is shown how maximum likelihood fitting can be used to estimate mean and variance of a discriminant for seismic event identification. (auth)

344 (ORNL-4836) EFFECTS OF ELECTROMAGNETIC PULSE (EMP) ON A POWER SYSTEM. Final Report. Marable, J. H.; Baird, J. K.; Nelson, D. B. (Oak Ridge National Lab., Tenn.). Dec 1972. 99p. Dep. NTIS $3.00.

The electromagnetic pulse (EMP), one of the effects of the detonation of a nuclear weapon, consists of a transient wave of intense electric and magnetic fields. These intense fields can cause malfunction or damage to electrical and electronic equipment exposed to EMP. Such malfunction and damage may be widespread if the detonation is at high altitude. The results of an investigation of the effects of EMP on an electric power distribution system are presented. Only the power circuitry and power components were considered in this study. This study is based on numerical and analytical calculations, on discussions with distribution company engineers and power-equipment manufacturer engineers, and on experimental work and field trips. Currents and voltages induced by EMP on distribution circuits as well as those reaching the consumer were calculated. A comparison with lightning pulses was made, and the protection presently used against lightning was explored. The results indicate that a distribution system should be able to survive a single EMP without extensive damage if it is well protected by lightning arresters. However, extensive lockout of reclosing breakers will occur from multiple detonations, and consumer equipment will be damaged from EMP pulses unless specifically protected. The resulting loss of load has serious implications concerning the system security of the entire power system. The alerting of the power industry and the development of a coordinated program of lightning and EMP protection is recommended, and further study of the stability of the power system is necessary. (auth)

345 (SLA-73-5196) PROJECT LN105: INTERMEDIATE-RANGE AIRBLAST. Vortman, L. J. (Sandia Labs., Albuquerque, N. Mex.). [nd]. 19p. (CONF-730318-2). Dep. NTIS $3.00.

From Defense Nuclear Agency's mixed company/middle gust meeting; Santa Barbara, California, USA (15 Mar 1973).

The principal purpose of Project LN105 was to document airblast in the low-overpressure region from a TNT surface burst. The data were to be used as a normalizing term in construction of an index of airblast suppression with depth of charge burial and type of stemming of buried bursts. A secondary objective was to compare measurements made on this program using Statham gages and measurements made with the microbarographs of Project LN106. The measurements also augmented those made on Project LN101 by providing information for a different azimuth, and bridging the region between the close-in measurements made on LN101 and those made on LN106. (auth)

346 (UCID-16147) CALCULATED SHOCK ENVIRONMENT OF FLAX EXPERIMENT STATIONS. Tokarz, F.; Hartzman, M.; Bernreuter, D. (California Univ., Livermore. Lawrence Livermore Lab) 9 Oct 1972. Contract W-7405-eng-48. 9p. Dep. NTIS $3.00.

Calculations were performed to estimate the effects of ground shock on two experiment stations in the stemming of the Flax Event, an underground nuclear explosion experiment. Data from other events indicated the possibility that ground shock pressures in the stemming might exceed the free field values. Therefore, consideration was given to adding hardware such as a rigid plastic plug which would couple the pipe string to the free field motion rather than to the higher stemming ground shock values. The analysis method is described. Calculations yielded maximum accelerations of 18.8 and 17.1 g's at the lower and upper experiment stations in the stemming based on the stemming motion estimates and no rigid plug in the pipe string. With a plug the values were reduced to 15.8 and 14.9 g's, respectively. (LCL)

347 (UCRL-51281) LONG-RANGE TRANSPORT, DIFFUSION, AND DEPOSITION FROM A RUSSIAN NUCLEAR EXCAVATION PROJECT. Dickerson, M. H.; Crawford, T. V.; Crandall, W. K. (California Univ., Livermore. Lawrence Livermore Lab.). 21 Sep 1972. Contract W-7405-eng-48. 38p. Dep. NTIS $4.00.

An investigation of the long-range diffusion and deposition of radioactive debris from 1004, a Russian nuclear excavation project is summarized. Measurements of air concentrations and surface deposition are compared to the results of calculations based on the U. S. computer code 2BPUFF. There was good agreement between airborne and surface measurements and calculations for the main debris cloud that passed over Japan at D + 5 to D + 6 days. The lower main cloud (850 mbar trajectory) and base surge calculations were mainly concerned with tritium concentration and deposition, since measurements of tritium were the only data supplied by the Russians and no other unambiguous data are available on these clouds. We found that wet deposition of tritium for the precipitation systems encountered by the lower 1004 nuclear clouds was not as important as washout of radioactive particulates due to tritiated water vapor following the water budget of the precipitation systems. Calculations of tritium wet deposition agreed with measurements for two distances along the path of the base surge. Calculations along the lower main cloud trajectory were not as close to measurements, although this particular trajectory explained the occurrence of tritium deposition at times of 10 days downwind but only 500 km from the 1004 ground zero. (auth)

348 (UCRL-51293) EFFECTS OF HEAT AND RADIATION ON GASBUGGY CHIMNEY GAS. Bozak, R. E.; Taylor, R. W. (California Univ., Livermore. Lawrence Livermore Lab.). 24 Oct 1972. Contract W-7405-eng-48. 23p. (PNE-G-81). Dep. NTIS $3.25.

Chemical changes in the gas in the Gasbuggy chimney were observed for about six months following the explosion. Heat and radiation are postulated to cause this change. Samples of gas taken from the chimney at one month were heated and irradiated in the laboratory. Heat produced a decrease in H_2 and an increase in CH_4 concentration—trends that were observed in the chimney. On the other hand, irradiated samples of this gas showed a dose-related increase in H_2 and decrease in CH_4. Irradiation also caused about one-third of each gas sample to change into an oil. (auth)

349 (UCRL-74055) APPROXIMATE METHOD FOR CALCULATING THE RESPONSE OF EMPLACEMENT STRUCTURES SUBJECTED TO GROUND SHOCK FROM UNDERGROUND NUCLEAR DETONATIONS. Hartzman, M. (California Univ., Livermore. Lawrence Livermore Lab). 17 Nov 1972. 29p. (CONF-721223-1). Dep. NTIS $3.50.

A method for calculating dynamic response of emplacement structures is described. It consists in replacing the structural system by an idealized lumped mass/finite element model. The equations of motion for each mass, expressed as functions of the internal and external forces, are solved in a step-by-step manner by a numerical algorithm. A running frictional pressure pulse applied to the external surface of the structure simulates the ground shock environment. Comparison of calculated response values with limited experimental data indicates reasonable agreement. (auth)

350 EFFECT OF NUCLEAR STIMULATION ON FORMATION PERMEABILITY AND GAS RECOVERY AT PROJECT GASBUGGY. Lemon, R. F.; Patel, H. J. (El Paso Natural Gas Co., TX). J. Petrol. Technol.; 24: 1199-1206(Oct 1972).

The effects of the Gasbuggy Event on the permeability of the geological medium surrounding the explosion and of the preshot permeability of the surrounding rock on the amount of natural gas which will flow into the nuclear chimney were investigated. Results from Gasbuggy indicate that the increase in permeability extends approximately 300 ft from the GB-ER well, or about 220 ft beyond the chimney of approximately 80-ft radius. The permeability beyond 300 ft does not appear to have been altered by the nuclear explosion. The calculated rock failure based upon the equations of state for the rock may be useful in estimating the extent of permeability increase for the exploitation of low-permeability gas reservoirs by nuclear stimulation. Irrespective of the size of the chimney and the permeability of the close-in region, gas eventually must flow into the chimney from the outer reaches of the drainage area of the well. Thus the preshot formation permeability is a most critical factor in calculating anticipated recovery from nuclear explosives. (LCL)

Protective Structures and Equipment

351 (LA-5236-PR) RESPIRATOR STUDIES RELATED TO THE AEC DIRECTORATE OF REGULATORY STANDARDS JULY 1 THROUGH DECEMBER 31, 1972. Hyatt, E. C.; Held, B. J.; Hack, A. L.; Pritchard, J. A.; Richards, C. P. (Los Alamos Scientific Lab., N. Mex.). Apr 1973. Contract W-7405-eng-36. 13p. Dep. NTIS $3.00.

The LASL Respirator Research and Development Section, Industrial Hygiene Group, continued to perform respirator studies for the Directorate of Regulatory Standards during the first half of FY 1973. The major work involved verification of proposed protection factors for half and full face respirators, evaluation of new devices, consultation services, and anthropometric studies. Progress from July 1, 1972 through December 31, 1972 is summarized. (auth)

Safety Engineering

Refer also to abstract 337.

352 (REG/G-8-5(2-73)) IMMEDIATE EVACUATION SIGNAL. (Directorate of Regulatory Standards (AEC), Washington, D. C.). 13 Feb 1973. 1p. DRS, Washington, DC Free.

353 (RT/PROT-(72)40) FUOCO: IBM 360 PROGRAM FOR THE CALCULATION OF THE CONSEQUENCES OF A SODIUM FIRE IN A CONFINED ROOM. Palma, F.; Sardone, D. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy). Divisione Affari Internazionali E Studi Economici). 29 Nov 1972. 60p. (In Italian). Dep. NTIS (U. S. Sales Only) $5.00.

A computer code able to evaluate the consequences of a sodium fire in a confined room connected with a larger one where the presence of ventilation can be considered is described. The code reduces the two rooms to a single room when the differential pressure between them is very small. A parametric analysis applied to the reference case and a comparison with the results reckoned by a different method has been carried out. (auth)

Vacuum Engineering

Refer also to abstract 759.

ENVIRONMENTAL AND EARTH SCIENCES

Minerals and Ores

Refer also to abstract 416.

354 (TID-26289) SOME FINANCIAL ASPECTS OF THE DOMESTIC URANIUM MINING AND MILLING INDUSTRY OVER THE NEXT FIFTEEN YEARS. Klemenic, J.; Berkoff, E. W. (Grand Junction Office (AEC), Colo.). 20 Oct 1972. 40p. Dep. NTIS $4.00.

Distribution of total expenditures by four capability classes is tabulated. The first class represents the seventeen production centers in operation on January 1, 1972; the second class represents the production centers under construction as of January 1, 1972; the third class represents production centers with sufficient reserves as of January 1, 1972, to warrant new facilities; and the fourth class represents production centers with insufficient reserves to support a production center but with enough potential to warrant consideration of new facilities. Also tabulated is unit costs in the form of $/$U_3O_8$ in concentrate. (DHM)

355 PECULIARITY OF THE ^{234}U BEHAVIOR IN VOLCANISM. Cherdyntsev, V. V.; Senina, N. I. (Inst. of Geology, Moscow). Geokhimiya; No. 1, 22-27(Jan 1973). (In Russian).

In volcanic rocks and minerals an inverse dependence of the $^{234}U/^{238}U$ ratio of uranium content is observed instead of the direct dependence, being usual for the surface zone of the Earth's crust. A low value of this ratio (up to $^{234}U/^{238}U = 0.5$ activity units) is found in radioactive specimens of young effusive rocks (including acid rocks) and their minerals. Separation of uranium isotopes in neovolcanic rocks cannot take place. The effect is connected with the different composition of flows, coming from the volcanic hearth: at first the matter with $^{234}U/^{238}U > 1$ and $U/Fe = 10^{-6}$ to 10^{-7} is transported and then the matter with $^{234}U/^{238}U < 1$ and $U/Fe = 10^{-5}$ to 10^{-4}. (auth)

356 PRESENT SITUATION OF FRENCH URANIUM. Com. Naz. Energ. Nucl., Notiz.; 18: No. 11, 73-76(Nov 1972). (In Italian).

The present situation of uranium supply and production in France and in the territories of the French area, with special regard to the contracting picture, are reviewed. (auth)

357 URANIUM PROSPECTING AND PRODUCTION ACTIVITIES OF RIO TINTO CORP. Com. Naz. Energ. Nucl., Notiz.; 18: No. 12, 73-75(Dec 1972). (In Italian).

A review of the organization and activities of Rio Tinto Corporation, which is one of the largest industrial groups engaged in uranium prospecting and production activities, is presented. (auth)

358 NATURAL PRECAMBRIAN NUCLEAR REACTOR. Berg, S. Sci. Avenir; No. 309, 878-880(Nov 1972). (In French).

The various stages in the discovery which led to the establishment of the existence of a naturally occurring self-maintained chain reaction 1700 million years ago in the Gabon deposit are presented. (FR)

359 SOME NEW DATA CONCERNING NUCLEAR CHAIN REACTIONS IN THE OKLO DEPOSIT. Baudin, G.; Blain, C.; Hagemann, R.; Kremer, M.; Lucas, M.; Merlivat, L.; Molina, R.; Nief, G.; Prost-Marechal, F.; Regnaud, F.; Roth, E. (CEN de Saclay, Gif-sur-Yvette, France). Compt. Rend., Ser. D; 275: No. 21, 2291-2294(20 Nov 1972). (In French).

The nature, age, duration, and mechanisms involved in the reactions of the Oklo deposit were studied by the chemical and isotopic analysis of Nd, Pb, rare gases, and water. Various other elements were studied. (FR)

Radioactive Effluents

Refer also to abstracts 439 and 1683.

360 (ARH-SA-113) RADIOACTIVE WASTE MANAGEMENT AT HANFORD. Kiel, G. R. (Atlantic Richfield Hanford Co., Richland, Wash.). 1972. Contract AT(45-1)-2130. 12p. (CONF-720347-1). Dep. NTIS.

The Hanford Plant, Richland, Washington, includes fuel fabrication facilities, the reactor plants located along the Columbia River, a fuel reprocessing plant, and extensive research and development facilities supporting all Hanford operations. Waste management and processing activities at the radiochemical fuel reprocessing facilities are described. Methods used for the prevention of release of radioactivity from gaseous, liquid, and solid wastes to the environment are discussed in detail. The effectiveness of these methods during 30 years of operation is indicated by the results of monitoring programs. (CH)

361 (EUR-4937) RADIOACTIVE POLLUTION: ITS ELIMINATION. Vaccarezza, J. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Apr 1973. 91p. (In French). Dep. NTIS (U. S. Sales Only) $6.75. EUR FB 125.-.

Problems of radioactive pollution and its elimination are considered. The first chapter deals with the principal radiochemical methods for the determination of radionuclides. The second indicates the physicochemical laboratory methods that are employed for the selection of the type of treatment. The treatment of liquid waste of medium and high radioactivity is investigated in the third chapter. The fourth chapter deals with the treatment of the concentrates. (~275 references) (auth)

362 (TID-4065-R-1) SUMMARIES OF USAEC ENVIRONMENTAL RESEARCH AND DEVELOPMENT. (Division of Biomedical and Environmental Research (AEC), Washington, D.C.). Mar 1973. 276p. Dep. NTIS $7.60.

Indexes prepared by Technical Information Center (AEC), Oak Ridge, Tenn.

Summaries of current environmental research and development funded by various divisions of AEC are presented. The 1001 summaries are organized into the following categories: transport and fate (of radioisotopes in the natural environment); measuring and monitoring (instrumentation and techniques for determining radiation exposures to man); evaluation of effects (both human health and safety and natural populations and species); and prevention and control technology (for handling, collection, treatment, and disposal of radioactive waste materials and effluents from the nuclear energy industry). Also included in the publication are contractor, principal investigator, and subject indexes. (ERB)

363 RADIOECOLOGICAL STUDIES IN FRANCE. CEN de Cadarache Group of Continental Radioecology. Grauby, A. (CEA, Paris). Proc. Jap. Conf. Radioisotop.; No. 10, 302-303 (Apr 1972). (In Japanese).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

Radioactive wastes released are not only diluted, but their intake into soil and living things is also a complicated manner. Before choosing the site of atomic energy installations, therefore, studies on geological systems most sensitive to radioactive substances and transfer of radioisotopes from system to system are necessary. Facilities of the CEN de Cadarache comprise a general laboratory of 800 m^2, a contamination greenhouse, breeding tanks for fish and shells, an artificial river model, cars and boats for sampling, and a gamma field. The radioecological work being carried out at the CEN de Cadarache is described: i.e., choosing the site of atomic energy installations, circulation of the radioactive substances in the environment, transfer of the radioactive substances into aquatic organisms and crops, and intake into the soil. (Japan)

Radioactivity Monitoring and Transport

Refer also to abstracts 347, 362, 363, 397, and 685.

364 (BNWL-B-250) INDEX OF ADEQUACY AND SOME OTHER STATISTICAL CONSIDERATIONS FOR AN ENVIRONMENTAL MONITORING SYSTEM. Johnston, J. W. (Battelle Pacific Northwest Labs., Richland, Wash.). Feb 1973. Contract AT(45-1)-1830. 75p. Dep. NTIS $5.75.

A statistical foundation for a guide for environmental surveillance of nuclear fuel fabrication plants is provided. In reviewing some of the literature and practices of environmental surveillance it became evident that little understanding of the procedures that make data (collected at great expense) amenable to inferential, as opposed to descriptive, statistical analysis was present in the sampling and isotopic analysis procedures. Consequently, much of the report is involved with giving basic statistical definitions, introducing a statistical model and suggesting methods for applying statistical principles to the collection of environmental data. The Preliminary Solution resulted in an index of adequacy for a particular nuclide-media combination that was called p_n and was to be compared with a standard P_n. The only variable quantity in this index was σ_T, the standard deviation of the random errors associated with estimating the quantity of interest. The particular statistical procedures given have attempted to show how various components of σ_T can be reduced and the factors that go into setting a feasible P_n, the criterion of adequacy. More extensive study is

required to determine explicit initial values for the P_n associated with the n nuclide-media combinations under surveillance. (auth)

365 (CEA-R-4373) METHODOLOGY FOR THE IDENTIFICATION OF A BIOLOGICAL INDICATOR IN RADIOECOLOGY: EXAMPLE OF ^{137}Cs AND A FRESHWATER MOLLUSC ANODONTA CYGNEA (L). Foulquier, L.; Lambrechts, A. (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires). Sep 1972. 295p. (In French). Dep. NTIS (U. S. Sales Only) $16.75.

In view of the fact that previous studies showed that freshwater bivalves were good indicators of ^{137}Cs contamination, experiments were undertaken to determine the main factors influencing the uptake of ^{137}Cs by Anodonta cygnea. Molluscs were placed in filtered and unfiltered water, water containing sediments, and water containing resuspended mud particles and yeast. Effects of age, temperature, and light on contamination levels were determined. Similar distributions of ^{137}Cs in various parts of the animal were observed under all experimental conditions. (HLW)

366 (SLA-73-339) ENVIRONMENTAL MONITORING REPORT FOR SANDIA LABORATORIES FROM 1964 THROUGH 1972. Brewer, L. W. (Sandia Labs., Albuquerque, N. Mex.). Mar 1973. 55p. Dep. NTIS $3.00.

By several different methods, water, soil and vegetation are regularly monitored and the results analyzed to assure that Sandia Laboratories' operations are not adversely affecting the surrounding environment. The data from these tests, primarily for radiation levels, are presented for the period from 1964 through December 1972. Results are tabulated for gross β counting. (HLW)

367 UTILITY SPONSORED ENVIRONMENTAL SURVEILLANCE AND RADIOECOLOGICAL RESEARCH PROGRAM FOR A COASTAL NUCLEAR POWER PLANT. Roessler, C. E. (Univ. of Florida, Gainesville); Bolch, W. E.; Gamble, J. F.; Johnson, W. B. Jr. Amer. J. Pub. Health; 62: No. 10, 1378-1386(Oct 1972).

At the site of the Crystal River Nuclear Power Plant, the utility company is satisfying its radiological surveillance responsibilities by means of contracts with the State health agency and with one of the state universities. In addition, the utility is supporting ecological research beyond that imposed by current regulatory requirements. The contract with the University has made a wide range of interests and expertise available to the project. Since both the State and utility have responsibilities that require them to conduct or support radiological surveillance, this cooperative program reduces tht total cost. Since the State health agency has entered into a similar agreement with respect to two other nuclear power plant sites in the State, standardization and intercomparability of data are assured. (auth)

368 ROLE OF ION EXCHANGE IN THE REMOVAL OF RADIUM FROM OCEAN WATER INTO SEDIMENTS. Kuznetsov, Yu. V.; Elizarova, A. N.; Lisitsyn, A. P.; Faizullin, F. Z. Sov. Radiochem. (Engl. Transl.); 14: No. 3, 448-452(1972).

Translated from Radiokhimiya; 14: No. 3, 441-446(1972).

A direct relationship was established between the cation exchange capacity of ocean sediments and their content of ^{226}Ra. It was hypothesized that ion exchange is one of the leading processes in the complex mechanism of the accumulation of radium on the ocean bottom. (auth)

Atmosphere

Refer also to abstracts 683, 684, and 727.

369 (ANL-8007) ENVIRONMENTAL MONITORING AT ARGONNE NATIONAL LABORATORY. Annual Report for 1972. Sedlet, J.; Golchert, N. W.; Duffy, T. L. (Argonne National Lab., Ill.). Mar 1973. Contract W-31-109-eng-38. 71p. Dep. NTIS $3.00.

The environmental monitoring program at Argonne National Laboratory for 1972 is described and the results are presented. To evaluate the effect of Argonne operations on the environment, measurements were made for a variety of radionuclides in air, surface water, soil, grass, benthos, and milk; for a variety of chemical constituents in surface and Argonne effluent water; and for the environmental penetrating radiation dose. Sample collections and measurements were made both on and off the Argonne site for comparison purposes. The results of the program are interpreted in terms of the sources and origin of the radioactive and chemical substances (natural, fallout, Argonne, and other) and are compared with accepted environmental quality standards. (auth)

370 (MLM-2015) RUGGEDIZED ULTRASENSITIVE FIELD AIR SAMPLER FOR DIFFERENTIALLY DETERMINING TRITIUM OXIDE AND GAS IN AMBIENT AIR ATMOSPHERE. Brown, R.; Meyer, H. E.; Robinson, B.; Sheehan, W. E. (Mound Lab., Miamisburg, Ohio). 6 Apr 1973. Contract AT(33-1)-Gen-53. 22p. Dep. NTIS $3.00.

In order to satisfy current upgraded monitoring requirements of Mound Laboratory's comprehensive environmental control and monitoring program, a continuing effort is being made to develop tritium air sampling which will provide a complete, reliable analysis of the ambient environment for tritium oxide and elemental tritium. The instrument described in this interim development report is an operational, practical, ruggedized, ultrasensitive, tritium field air sampler assembled for the simultaneous, differential sampling of the environmental air for tritium oxide and elemental tritium. The system uses hardware assembled and packaged in such manner as to facilitate use in the field as well as in the laboratory. The sampling system occupies relatively small space and is simple to operate. The detection sensitivity approaches tritium background levels. This sensitivity is achieved by high volume sampling, efficient removal of tritium oxide and elemental tritium ("tritium gas"), and counting the recovered fractions by liquid scintillation spectrometry. The Mound Laboratory environmental monitoring capability was improved significantly by the addition of this monitoring system to the already comprehensive instrumentation in daily use by the Laboratory. (auth)

371 (RT/PROT-(72)7) NOMOGRAMS FOR THE COMPUTATION OF THE ATMOSPHERIC DIFFUSION OF A RADIOACTIVE POLLULANT. Frittelli, L. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 23 Nov 1972. 10p. Dep. NTIS (U. S. Sales Only) $3.00.

A series of nomograms is presented for a quick and fairly precise computation of the diffusion in the atmosphere of a radioactive pollulant. (auth)

372 (UCID-16162) PRECIPITATION SCAVENGING AND 2BPUFF. Crawford, T. V. (California Univ., Livermore. Lawrence Livermore Lab.). 6 Dec 1971. Contract W-7405-eng-48. 10p. Dep. NTIS $3.00.

Two methods for use of the computer code 2BPUFF in calculations of radionuclide scavenging by precipitation (rain or snow) along the trajectory of a radioactive cloud are discussed. One method uses the calculated vertical integral through the cloud center as a function of time to estimate the deposition rate at various downwind distances. The second method is based on calculations of the depletion of material in the cloud as a function of time in relation to the input precipitation rate along the cloud trajectory. The first method gives most favorable comparison with calculations in the absence of details on the precipitation characteristics. The latter method gave reasonable agreement with calculations based on Cabriolet data. (CH)

373 (UCRL-51283) IN-CLOUD PRECIPITATION SCAVENGING OF TRITIATED WATER VAPOR. Dickerson, M. H.; Crawford, T. V. (California Univ., Livermore. Lawrence Livermore Lab.). 22 Sep 1972. 7p. Dep. NTIS $3.00.

A method for calculating the deposition of tritium following a nuclear burst considers the interaction of tritiated water vapor with precipitation. It calculates the long-range wet deposition of tritium from the calculated debris-cloud concentration and the measured total rainfall, temperature, and dew point. The method was tested by using data from a Russian nuclear excavation experiment. The calculated values were from 0.2 to 2.5 times the measured values. The differences may reflect the limited meteorological and deposition measurements, the highly variable topography, and uncertainties in wind velocity and direction. (auth)

374 VARIATION AND BUILD-UP OF ENVIRONMENTAL β ACTIVITY. Srivastava, S. C.; Khalsa, S.P.S.; Das, S. K.; Banerji, K. C. (Fertilizer Corp. of India Ltd., Sindri). Technology (Sindri); 9: No. 1, 62-64(1972).

Diurnal variations of the environmental radon and thoron concentrations were studied and discussed. The build-up and decay of the gross β activity inside the active zone of the Radio-Isotope Laboratories in P & D Division, FCI Ltd., Sindri, were also investigated with and without the operation of ventilation system. Similar studies were extended inside an unventilated closed room. The results were compared with the corresponding values of maximum permissible concentration (mpc) as recommended by the International Commission for Radiation Protection (ICRP). Moreover, neither any variation of the environmental β activity nor any effective contribution towards the same due to handling of unsealed radioisotopes was marked inside the different rooms of the laboratories. (auth)

375 MEASUREMENTS ON THE RAISING LEVEL OF THE RADIOKRYPTON CONCENTRATION OF ATMOSPHERE. Csongor, E. (MTA Atommag Kutato Intezete, Debrecen, Hungary). Izotoptechnika; 16: No. 2, 96-104(Feb 1973). (In Hungarian).

The results of measurements of ^{85}Kr in the atmosphere since 1958 (in foreign countries) and since 1966 in Hungary are given. The increases reflected in the data can be attributed to the operation of nuclear power plants and reprocessing plants. (ERB)

Soil

376 (CEA-R-3635(2)) SOIL CONTAMINATION. 2. Movements of Radioactive Ions in Nonsaturated Soils After Reject in a Limited Space. Rancon, D. (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires). Feb 1973. 50p. (In French). Dep. NTIS (U. S. Sales Only) $4.50.

Water movements in non-saturated soils after reject on a limited space were measured using the radioactive ions ^{131}I and ^{85}Sr (an anion and a cation). The experimental method is based on the simultaneous measurements of moisture and radioactivity by means of a neutrons moisturemeter and an especially designed radioactivity probe. It was possible to measure: the relative velocities of moisture and radioactivity fronts; the contaminated soil volume inside the moistened soil volume; the concentration gradients; the contamination changes on watering; the effect of chemical composition of water on ion movements; and the effect of soil moisture on the counting rate of radioactivity. This method can be generalized to other radioisotopes and other soils. They are applicable to radiological safety monitoring of sites; testing storage facilities; estimates of accidents hazards; and protection of subterranean waters. (auth)

377 (WASH-1225) ON THE NATURAL REDISTRIBUTION OF SURFACE CONTAMINATION. Trevino, G. (Division of Biomedical and Environmental Research (AEC), Washington, D. C.). Nov 1972. 8p. GPO $0.35.

Because any ground-deposited contamination will attach itself to host particles (soil grains), the subsequent redistribution of the contamination by the wind will depend upon the wind-induced motion of the hosts. Within the following text, a mathematical model is developed, utilizing power-spectral techniques, by which use the effects of the wind can be accounted for. Underlying the development is the inherent assumption that only those particles in the soil whose size does not restrain them from being moved, directly or indirectly, by the wind are of primary importance while those particles that cannot be moved by the wind are of secondary importance. (auth)

378 STUDIES ON RADIOACTIVE FALLOUT IN SOILS OF VARIOUS TYPES. Kawase, K. (Niigata Univ., Japan). Proc. Jap. Conf. Radioisotop.; No. 10, 562-567(Apr 1972).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

From the necessity of knowing the degree of contamination on the Earth's surface by fallout from past nuclear detonations for future discussion on environmental radioactivity due to nuclear power generation, a number of studies on the distribution and moving mechanism of ^{90}Sr and ^{137}Cs in the various types of soils in Niigata Prefecture have been made. Soil samples taken from fifteen localities in 1965-1968 include paddy soil, field soil, forest soil, and lagoon soil, and the sampling depth ranges from 10 to 70 cm. The ^{90}Sr was measured by radioactive strontium analysis and the ^{137}Cs by γ spectrometry. The concentration of the ^{90}Sr measured (mCi/km^2) ranged from 18 to 316 (mostly 100 to 200), and that of the ^{137}Cs ranged from 79 to 451 (mostly 200 to 400). $^{137}Cs/^{90}Sr$ ranges from 1.5 to 2.9. From these results, it was concluded that the effect of the contamination is great. The maximum values of the ^{90}Sr and ^{137}Cs cited above are the highest in Japan for the concentration of these nuclides caused by fallout. (Japan)

Water

379 ^{32}Si PROFILES IN THE SOUTH PACIFIC. Somayajulu, B. L. K.; Lal, D.; Craig, H. (Scripps Institution of Oceanography, La Jolla, CA). Earth Planet. Sci. Lett.; 18: No. 2, 181-188(Mar 1973).

Si and ^{32}Si were collected from samples of up to 375,000 l of seawater using an in-situ extraction technique with ferric-hydroxide-loaded natural sponges contained in "butterfly" samplers. Results of measurements of dissolved ^{32}Si and stable silicon in three vertical profiles in the South Pacific (23°-21°S; 175°E-177°W) are compared with ^{32}Si specific activities observed in shallow and deep-water siliceous sponges collected from the Pacific, and with theoretical calculations of the ^{32}Si production rate in the atmosphere by cosmic radiation. Good agreement exists between the production rate, the fallout rate, and the ^{32}Si oceanic inventory of $(2 \pm 0.5) \times 10^{-2}$ (dpm/cm^2) obtained from the South Pacific profiles. (auth)

Ecosystems and Food Cycles

380 (DP-1323) SAVANNAH RIVER PLANT SITE. Langley, T. M.; Marter, W. L. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Jan 1973. Contract AT(07-2)-1. 160p. Dep. NTIS $7.60.

A description is presented of the geological, hydrological, meteorological, and ecological characteristics of the Savannah River Plant site. It is intended as a source of information for those interested in environmental research at the site. The site, which borders the Savannah River for 22 miles, includes swampland, pine forests, abandoned town sites, a large man-made lake for cooling water impoundment, fields, streams, and watersheds. It is also intended as a reference for those preparing reports about aspects of operation of production and support facilities at the Savannah River Plant. Much of the information in this document was extracted from the 66 references listed at the end of the report. (CH)

381 TRANSFER AND CONCENTRATION OF RADIONUCLIDES IN MARINE ORGANISMS. Saiki, M. (National Inst. of Radiological Sciences, Chiba, Japan). Proc. Jap. Conf. Radioisotop.; No. 10, 568-576(Apr 1972).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

Information on the concentration of the radionuclides from seawater to marine organisms provides an important clue for estimating internal radiation exposure of man due to the intake of marine food. The main routes of the radionuclides in seawater to fish are absorption of the radionuclides dissolved in seawater directly through gills, absorption through food such as plankton, benthos, seaweed, and small fishes, through the intestinal canal of fish, and absorption from the seawater taken into the intestinal canal, since marine fish take a considerable amount of water for the control of osmotic pressure. The uptake of radioactivity in the marine organisms is affected not only by the type of radionuclides, but also by the chemical and physical forms of the radionuclides in seawater. In an experiment on ^{106}Ru, the hydrochloride form was easily absorbed in the soft tissues of the marine organisms. As to the form of ^{144}Ce in seawater, a high distribution rate was found in the particulate or colloidal form according to the results of the fallout survey. However, according to the investigation with tracers, it was clarified that a considerable fraction of the Ce was lost from seawater, caused by the adsorption of suspended matter or by coprecipitation with other metal hydroxides rather than by colloid formation itself. The high concentration of ^{144}Ce in the livers of fish observed by the tracer experiment also suggested that Ce was accumulated in soluble form. It was also accumulated by the uptake through gills or scales by surface adsorption. Then as results of the investigation on the concentration factor, concentration and loss are presented in detail for the following radionuclides: ^{137}Cs, ^{85}Sr, ^{90}Sr, ^{60}Co, ^{59}Fe, and ^{106}Ru. (Japan)

382 STATISTIC ANALYSIS OF β RADIOACTIVITY OF THE PERIPHYTON IN THE SHALLOW RESERVOIR OF THE BARRAGE. Kwapulinski, J. Nukleonika; 17: No. 10, 529-535(1972). (In Polish).

The limnological condition in the reservoir influenced the radioactivity of the periphyton. The average β radioactivity of the periphyton as a function of the time may be determined by the following formula $A'_p = 45.9.t^{-0.991}$, where t is day. (auth)

383 BEHAVIOR OF TRACE ELEMENTS IN SEAWATER AND MARINE ORGANISMS. Saiki, M. (National Inst. of Radiological Sciences, Chiba, Japan). Proc. Jap. Conf. Radioisotop.; No. 10, 298-301(Apr 1972). (In Japanese).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

The behavior of trace elements in seawater, sediment on the sea bottom, and in marine organisms was observed and calculated. The average remaining period of ^{90}Sr and ^{137}Cs in seawater to a depth of 500 m from the surface is 4.5 and 3 yr, respectively. Concentration of the trace elements in sediment on the sea bottom was studied by the quantitative analysis of radioactive fallout and a radioisotope tracer method. The elements are adsorbed differently at the sea bottom; distribution coefficients for a sample are ^{90}Sr: 30, ^{137}Cs: 200, ^{144}Ce: 10^4, ^{106}Ru: 10^4, and $^{95}Zr-^{95}Nb$: 10^4. Stable Sr, stable Cs, and ^{90}Sr from radioactive fallout in seawater, fish bone, shell, and seaweed were measured to observe accumulation of the Sr in marine organisms. Observed ratios, i.e., Sr/Ca in organism : Sr/Ca in seawater, for the fish bone, shell, and brown seaweed are 0.27, 0.19, and 3.67, respectively. The behavior of Ru is also discussed. (Japan)

384 PLUTONIUM MOBILITY IN SOIL AND UPTAKE IN PLANTS: A REVIEW. Francis, C. W. (Oak Ridge National Lab., TN). J. Environ, Qual.; 2: No. 1, 67-70(1973).

A survey of the published literature pertaining to the movement of plutonium in soil and uptake in plants reveals that a major portion of the investigations pertain to soils developed under arid or semiarid climates. In some instances subsoil samples were used to describe plutonium adsorption characteristics and often

short-term greenhouse experiments were used to predict plant uptake. Some recent long-term greenhouse studies indicate a substantially greater plant uptake of plutonium from a highly contaminated soil after 5 years of cropping as compared to the first year. It appears the most likely mode of plutonium entry into food chains leading to man would be that chelated with naturally occurring organic soil components. Chelation mechanisms have not been established. (20 references) (auth)

385 TRANSURANIC ELEMENTS IN SOILS, PLANTS, AND ANIMALS. Price, K. R. (Battelle Pacific Northwest Labs., Richland, WA). J. Environ. Qual.; 2: No. 1, 62-66(1973).

Published information concerning the distribution and fate of neptunium, plutonium, americium, and curium in terrestrial ecosystems is reviewed, and areas needing further study are identified. The studies conducted indicate that transuranic elements do not remain in solution in soils, plants, or animals, but organic complexes and chelation greatly enhance mobility. The elucidation of natural organic complexes and chelating agents has not been attempted. Oxidation state also influences mobility, but possible biological mechanisms permitting oxidation or reduction remain uninvestigated. Ingestion is the most important transfer mechanism in ecosystems, but assimilation of transuranics from natural food sources is mostly unknown. Evidence in the literature suggests three possible mechanisms leading to the observed increase in plant uptake with time: the formation of organic complexes or chelates, a buildup of radionuclide concentration at root surface, or the slow but continual uptake by perennial plants. Each of these mechanisms deserves further study. (auth)

386 γ-SPECTROMETRY OF ENVIRONMENTAL SAMPLES AND THE EVALUATION OF DATA WITH COMPUTER. Kovacs, M.; Beleznay, F.; Andrasi, A.; Erdelyvari, I. (MTA Koezponti Fizikai Kutato Intezete, Budapest). Izotoptechnika; 16: No. 2, 84-95(Feb 1973). (In Hungarian).

A method is described for the rapid evaluation of up to seven γ-emitting components of contamination without chemical separation. Analyses were performed on ashed food samples. (ERB)

387 STRUCTURE AND CATION CONTENT OF PODZOLIC SOIL OF LONG ISLAND, N. Y., SEVEN YEARS AFTER DESTRUCTION OF THE VEGETATION BY CHRONIC GAMMA IRRADIATION. Horrill, A. D.; Woodwell, G. M. (Brookhaven National Lab., Upton, NY). Ecology; 54: No. 2, 439-444(Apr 1973).

Chronic gamma irradiation of an oak-pine forest in central Long Island, New York, has reduced the structure of the forest systematically and started changes in the structure and nutrient content of the soils. The most important changes have been reduction of the litter and humus horizons and a decline in loss-on-ignition in most horizons. Nutrient content of soils has clearly been augmented by minor disturbance of the vegetation and reduced by more severe disturbance. The soil content of phosphorus and calcium were exceptions, increasing along the gradient of radiation toward the highest exposures. (auth)

Radiometric Techniques

Refer also to abstracts 376 and 755.

388 DISPERSION DIAGRAMS, A New Approach to the Display of ^{14}C Dates. Ottaway, B. (Univ. of Edinburgh). Archaeometry; 15: No. 1, 5-12(Feb 1973).

A statistical approach to the display of sets of ^{14}C dates is suggested. All available dates of any particular culture are used to calculate the two quartiles and the median dates for it. The "dispersion" of the dates is then displayed as a bar showing the extreme dates, the quartiles and the median; thus neither individual dates nor their standard deviations are shown. This "dispersion diagram" saves much space when the dates of several cultures are to be displayed. The argument is developed that the inter-quartile range, which does not change very much when new dates become available and are added to the set, is a good index of the time span during which a culture flourished, and this range should normally be quoted rather than the mean, median or extreme dates of the culture. With samples of nine or more it can be shown by the Hypergeometric Distribution that there is a 97% chance of two cultures being different if their inter-quartile ranges just fail to overlap, so that this method of display is useful in assessing the overlap of cultures. The fact that the dispersion diagram contains within it a measure of the statistical uncertainties of the individual estimates and therefore can replace the standard deviation of each individual ^{14}C date is discussed. (auth)

389 GEOCHEMICAL STUDIES ON THE NATURAL AND ARTIFICIAL RADIONUCLIDES IN NATURE. Yamagata, N. (Inst. of Public Health, Tokyo). Proc. Jap. Conf. Radioisotop.; No. 10, 292-294(Apr 1972). * (In Japanese).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

Various examples of radiochemical analyses using natural and artificial radionuclides for the determination of sedimentary speed of suspensions in ocean and atmosphere are cited. In these analytical works that are referred to, much improvement and advanced devices are seen in analytical techniques. Falling speed of the suspensions in the North Pacific, measured with ^{234}Th, is 1 to 3 × 10^{-3} cm/sec (1 to 3 m/day). The sedimentary speed of deep-sea bottom sediments in Pacific areas, measured by the ionium–thorium method ($^{230}Th-^{232}Th$) is from 8 mm/1000y to 0.8 to 2.4 mm/1000y which well coincides with 4 mm/1000y obtained by systematic radiochemical analysis using thorium, protoactinium, and uranium isotopes. $^{228}Th/^{232}Th$ has also been utilized for the measurement of Th concentration obtained as 2.2 × 10^{-9} g/l, and the radioactive ratio of these nuclides was 128 in maximum in the Northwest Pacific. The change in ^{14}C and ^{3}H contents in the atmosphere before and after the stop of nuclear experiments has been used for the analyses of distribution and movement of terrestrial waters and the estimation of suspending period of the fallout such as ^{90}Sr in stratosphere and troposphere. (Japan)

Site Surveys

Refer also to abstracts 363, 380, 401, 1675, 1801, and 1809.

390 (CEA-CONF-2132) PROPAGATION IN ONE DIMENSION OF SHOCK WAVES IN SOLIDS. Application to Soils. Meunier, J. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Sep 1972. 33p. (In French). (CONF-720977-1). Dep. NTIS (U. S. Sales Only).

From 1st conference on soil mechanics; Chatenay-Malabry, France (26 Sep 1972).

The existence of shock waves in a perfectly elastic one-dimensional medium is demonstrated, and the calculation is justified experimentally by the visualization of shock waves in a helical spring. The fundamental equations of the theory of shocks are presented, and the problem of the transmission of shock waves from one medium into another is studied by means of shock polarity. Some schemes make explicit, in the various possible cases, the passage of a perturbation between two media. Finally the problem of shock waves in a perfectly plastic medium is dealt with. The results of practical experiments on samples of clay (loam) complete the study on plastic waves. (tr-auth)

391 (NVO-362-12) SITE SURVEY FOR RUN-UP GAUGES, AMATIGNAK, RAT, AND SEMISOPOCHNOI ISLANDS. (General Motors Corp., Santa Barbara, Calif. Delco Electronics Div.). Dec 1970. Contract AT(26-1)-362. 25p. (TR-70-107). Dep. NTIS $3.25.

This report describes surveys of three Aleutian Islands — Amatignak, Rat, and Semisopochnoi — to select sites for run-up gauges for the water wave program of project CANNIKIN. The site survey was conducted by Lloyd Sorensen of Delco Electronics Division, General Motors Corporation, between 1 October and 21 October 1970. (auth)

392 (USGS-474-26(Rev. 1)) HYDRAULIC TESTS IN HOLE UAe 3, AMCHITKA ISLAND, ALASKA. Amchitka-17, Revision 1. Ballance, W. C. (Geological Survey, Lakewood, Colo. (USA)). Apr 1973. Contract AT(29-2)-474. 34p. Dep. NTIS $4.00.

Inflatable straddle packers were used to isolate and test selected intervals in hole UAe-3. Packer seats were poor in the uncased part of the hole because of unstable wall conditions, and leakage around packers occurred during some tests. However, leakage generally was slight, as shown on pressure-gage charts, and had little effect on the tests. The static water levels in the intervals tested ranged from 31.6 meters (104 feet) below land surface in the upper interval tested to about 115 meters (377 feet) below land surface in the lower interval tested, indicating decreasing head with depth. The relative specific capacities of isolated zones ranged from less than 0.001 cubic meter per day per meter (less than 0.001 gallon per minute per foot) of drawdown to 0.898 cubic meter per day per meter (0.050 gallon per minute per foot) of drawdown. (auth)

393 (USGS-474-104) HYDRAULIC TESTS IN HOLE UAe-6h, AMCHITKA ISLAND, ALASKA. Amchitka-13. Ballance, W. C. (Geological Survey, Lakewood, Colo. (USA)). Oct 1972. Contract AT(29-2)-474. 34p. Dep. NTIS.

The static ground water levels in hole UAe-6h during the intervals tested ranged from about 23 meters (71 feet) below land surface in the upper interval to an estimated 90 meters (295 feet) below land surface in the lower intervals, indicating a decreasing head with depth. The specific capacity of the hole from 85.0 to 2,133.6 meters (279 to 7,000 feet) was 1.94 cubic meters per day

per meter (0.11 gallon per minute per foot) of drawdown after the hole had been jetted at an average rate of 327 cubic meters per day (60 gallons per minute) for about 23 hours. Transmissivity computed from the recovery of water level after jetting stopped was 0.60 cubic meter per day per meter (48.3 gallons per day per foot). The relative specific capacities of isolated intervals ranged from 0.004 cubic meter per day per meter (less than 0.001 gallon per minute per foot) of drawdown to 0.430 cubic meter per day per meter (0.024 gallon per minute per foot) of drawdown. (auth)

394 (USGS-474-150) HYDRAULIC TESTING AND SAMPLING OF HOLES RB-E-01 AND RB-D-01, PROJECT RIO BLANCO, RIO BLANCO COUNTY, COLORADO. Rio Blanco-1. Weir, J. E. Jr. (Geological Survey, Lakewood, Colo. (USA)). Nov. 1972. Contract AT(29-2)-474. 30p. (PNE-RB-32). Dep. NTIS.

The discharge of water during drilling of two holes (RB-E-01 and RB-D-01) at the Rio Blanco site in western Colorado was monitored. Recovery of water level was measured following periods of water withdrawal from hole RB-D-01. Two intervals of hole RB-D-01 were tested. Zone 1, from 245 to 845 feet below land surface, has a transmissivity of about 4,600 gallons per day per foot and a static water level of 59.90 feet below land surface. Zone 2, from 882 to 1,651 feet below land surface, has a transmissivity of about 200 gallons per day per foot and a static water level of 39.63 feet below land surface. There is potential at hole RB-D-01 for flow of water upward from zone 2 to zone 1; however, differences in quality of water in the two zones indicate that water probably does not circulate freely between the zones. (auth)

395 (USGS-474-151) LITHOLOGIC LOGS AND STRATIGRAPHIC IDENTIFICATION OF EXPLORATORY AND EMPLACEMENT DRILL HOLES IN AREA 3, NEVADA TEST SITE. Dixon, G. L.; Sargent, K. A.; Spengler, R. W. (Geological Survey, Denver, Colo.). Mar 1973. Contract AT(29-2)-474. 138p. Dep. NTIS. $9.25.

This report is a compilation of lithologic logs of exploratory and emplacement holes in Area 3, Nevada Test Site, with emphasis on identification of Tertiary volcanic units. An index map showing drill-hole locations and contours of the elevation of the Tertiary water level in Area 3 is included. (auth)

396 (USGS-474-156) WATER INFLOW INTO HOLE UA-1, AMCHITKA ISLAND, ALASKA. Amchitka-34. Ballance, W. C.; Beetem, W. A. (Geological Survey, Lakewood, Colo. (USA)). Dec 1972. Contract AT(29-2)-474. 33p. Dep. NTIS.

Hole UA-1 was constructed for studies on the testing on underground nuclear device. Chemical composition of water samples, temperature of inflow water, and theoretical calculations were compared to evaluate the water-contributing intervals to the zone to be mined. Chemical composition and temperature of inflow water indicated the contributing zones to have a mean depth of 1,670 meters (5,478 feet) and 1,726.7 meters (5,665 feet), respectively. An unrestricted inflow rate based on this data was calculated to be 380 cubic meters per day (70 gallons per minute) which compared well with the measured restricted-inflow rate of 164 cubic meters per day (30 gallons per minute) for hole UA-1 at the end of November 1970. (CH)

397 (USGS-474-158) WATER QUALITY AND PHYSICAL CHARACTERISTICS OF NEVADA TEST SITE WATER-SUPPLY WELLS. Claassen, H. C. (Geological Survey, Lakewood, Colo. (USA)). Jan 1973. Contract AT(29-2)-474. 152p. (NTS-242). Dep. NTIS.

Chemical, radiochemical, and hydraulic data obtained by the U. S. Geological Survey from the water-supply wells at the Nevada Test Site are presented. Time variations in these parameters are discussed and evaluated. A diagrammatic representation of well construction and lithology penetrated is included for each well. (auth)

398 ARGUMENT FOR THE OPEN OCEAN SITING OF COASTAL THERMAL ELECTRIC PLANTS. Tarzwell, C. M. (Environmental Protection Agency, West Kingston, RI). J. Environ. Qual.; 1: No. 1, 89-91(1972).

Effects of nuclear and fossil-fueled thermal electric generating plants are considered. Chlorination of the intake water is lethal to a high percentage of planktonic and other organisms; thermal shock is detrimental to some of the more sensitive forms; continued exposure to high temperatures after thermal shock is lethal to many forms, especially zooplankton; screening and turbulence in such plants is lethal to larval fishes and several invertebrates, and immense amounts of waters are put through the plant and such transfer can be detrimental. It is concluded that in most instances, bays and estuaries are not suitable for the location of a number of thermal electric plants. Discharges to the open ocean are encouraged on the basis that acre for acre bay and estuarine waters are more important and valuable for the production of marine life than is the open ocean. It is recommended that the plants be so located, or corrective measures built in, so that they cause the least amount of damage to the aquatic environment and the various water uses. (auth)

Thermal Effluents

Refer also to abstract 1951.

399 (GULF-GA-A-12346) PLUME BEHAVIOR AND POTENTIAL ENVIRONMENTAL EFFECTS OF LARGE DRY COOLING TOWERS. Final Report. Boyack, B. E.; Kearney, D. W. (Gulf General Atomic Co., San Diego, Calif). Feb 1973. Contract AT(04-3)-167. 189p. Dep. NTIS $7.60.

Results are presented from a study on the hot air plume behavior and possible effects on the environment of the waste heat rejected from 1000-MW(e) power generating plants by dry cooling tower systems. A comprehensive literature survey (137 references) was conducted to define the current state-of-the-art related to this problem. Publications related to dry cooling tower systems, the behavior of dry hot plumes, and the environmental effects associated with the discharge of energy directly to the atmosphere were reviewed and are discussed. Papers dealing with plume rise and the meteorological consequences of manmade heat rejection systems are reviewed and evaluated in relation to dry cooling tower systems. The plants chosen were a light water reactor plant with a rated efficiency of about 33% and fossil-fuel and high-temperature gas-cooled reactor plants with rated efficiencies close to 39%. Both mechanical-draft and natural-draft towers were sized for these plants in order to determine the conditions of the plume at the tower exit, i.e., altitude, diameter, exit air temperature, and velocity. (MCG)

400 (HEDL-TME-72-103) COLHEAT RIVER SIMULATION MODEL. (Hanford Engineering Development Lab., Richland, Wash.). Aug 1972. Contract AT(45-1)-2170. 79p. Dep. NTIS.

The COLHEAT river simulation model has been used primarily to simulate water temperatures in a flowing stream. However, the mathematical model, originally developed to estimate the effect on the Columbia of the Hanford Production reactors, has been formulated and structured in such a manner that it can be used to simulate the behavior of pollutants other than waste heat. Testing and application of the model to real world situations have prompted development of specialized routines to include provisions for handling transient flow, reverse flow, diffusional transport, and density currents. The model has been tested under a variety of conditions and has given excellent results. Discussions of the underlying theory, the development of the computer model, the results of various model tests, and a brief user's guide are included. (auth)

401 (HEDL-TME-72-110) ENVIRONMENTAL ENGINEERING PROGRAMS. Quarterly Technical Progress Report, April-June 1972. Bailey, G. F. (comp.). (Hanford Engineering Development Lab., Richland, Wash.). Dec 1972. Contract AT(45-1)-2170. 31p. Dep. NTIS $3.75.

Technical progress made by Westinghouse Hanford Company and its subcontractors during April, May, and June, 1972 is summarized. The three major programs reported are: simulation modeling of environmental effects of thermal generation; regional modeling of surface water temperatures from projected power growth; and engineering evaluation of environmental aspects of nuclear plant siting. (ERB)

402 CONFERENCE ON BENEFICIAL USES OF THERMAL DISCHARGES, ALBANY, NEW YORK, SEPTEMBER 17-18, 1970. Mathur, S. P.; Stewart, R. (eds.). Albany; State University of New York (1970). 227p. (CONF-700986-). $10.00.

From conference on beneficial uses of thermal discharges; Albany, New York, USA (17 Sep 1970).

Separate abstracts were prepared on the 14 papers presented at this conference. (CH)

For abstracts of individual papers see: 403-414, 1951, and 1952.

403 TRENDS OF POWER GENERATION AND THERMAL DISCHARGES IN NEW YORK STATE. Brown, D. H. (General Electric Co., Schenectady, NY). pp 8-18 of Conference on Beneficial Uses of Thermal Discharges. Mathur, S. P. (ed.). Albany; State University of New York (1970).

From conference on beneficial uses of thermal discharges; Albany, New York, USA (17 Sep 1970). See CONF-700986-.

The thermal discharge via plant condensers of steam-electric plants each year in New York State will increase from 400 trillion BTU in 1970 to 1,340 trillion in 1990. Current thermal criteria would accommodate this increase with continued use of once-through condenser cooling. If more stringent cri-

teria mandate use of cooling ponds, cooling towers, and long ocean outfall, then by 1990 over half the installed capacity would use cooling towers. The basic physics of steam-electric power production are briefly reviewed. Thermal exhaust is shown to be mandatory. Increase of exhaust temperature is shown to result in greater than normal thermal exhaust. The thermal exhaust in 1990 is compared to the natural solar heating and the natural evaporation in New York State to indicate its environmental magnitude. (auth)

404 DEVELOPMENT OF SYSTEMS OF MARINE FISH CULTIVATION IN THE UNITED KINGDOM. Richardson, I. D. (White Fish Authority, London). pp 19-28 of Conference on Beneficial Uses of Thermal Discharges. Mathur, S. P. (ed.). Albany; State University of New York (1970).

From conference on beneficial uses of thermal discharges; Albany, New York, USA (17 Sep 1970). See CONF-700986-.

The feasibility of rearing marine fish to marketable size in sheltered waters on the West Coast of Scotland and in the warm water discharge of electrical generating stations is being examined. Progress made in the last five years is described and it is concluded that the feasibility of rearing fish to marketable size is established. It is possible to identify many of the problems requiring investigation before a costed technology is available. (CH)

405 MARICULTURE IN JAPAN USING HEATED EFFLUENT WATER. Yang, W. T. (Univ. of Miami, FL). pp 29-43 of Conference on Beneficial Uses of Thermal Discharges. Mathur, S. P. (ed.). Albany; State University of New York (1970).

From conference on beneficial uses of thermal discharges; Albany, New York, USA (17 Sep 1970). See CONF-700986-.

The present status of aquaculture of fish and shrimp in Japan is reviewed. Several species lend themselves well to aquaculture methods, including kuruma shrimp and yellowtail. Recent developments in the utilization of thermal effluents, especially from power plants, have shown that rapid growth occurs during the usually non-productive winter months, with no loss of commercially desirable characteristics. Usually growth rates in heated effluent are many times higher compared to those seen in animals cultured in the natural environment. Such results suggest that extensive use of heated effluents may be one method which can be utilized to lower the present high price of seafood, especially in the off season. (CH)

406 CATFISH FARMING: BENEFICIAL USE OF WASTE HEAT. Pickering, C. W. (Catfish Farmers of America, Laurd, MS). pp 46-50 of Conference on Beneficial Uses of Thermal Discharges. Mathur, S. P. (ed.). Albany; State University of New York (1970).

From conference on beneficial uses of thermal discharges; Albany, New York, USA (17 Sep 1970). See CONF-700986-.

The catfish farming industry in the USA is described. The advantages of using thermal effluents from power plants to increase the growth rate of the fish during the winter months are discussed and farms using thermal effluents are described. (CH)

407 BIOLOGICAL LIMITATIONS ON THE USE OF WASTE HEAT IN AQUACULTURE. Coutant, C. C. (Oak Ridge National Lab., TN). pp 51-61 of Conference on Beneficial Uses of Thermal Discharges. Mathur, S. P. (ed.). Albany; State University of New York (1970).

From conference on beneficial uses of thermal discharges; Albany, New York, USA (17 Sep 1970). See CONF-700986-.

Although warmer water generally stimulates growth of aquatic organisms, the easy availability of warmed nuclear and fossil-fueled power station coolant does not necessarily assure success of aquaculture. Certain biological limitations must be carefully considered, such as: the complex relationships among temperature, food utilization, and growth; metabolic and food waste products and their effects on the receiving water (compared to the effects of heat alone; uptake of radionuclides by cultured species (and acceptance as human food); and tolerances of organisms to biocides and temperature changes caused by variations in plant operation. Some of these biological limitations may inflict severe economic ones as well, and thus affect the feasibility of aquaculture projects. (auth)

408 THERMAL-WATER HORTICULTURAL DEMONSTRATION PROJECT AT SPRINGFIELD, OREGON. Miller, H. H. Jr. (Vitro Corp. of America, Portland, OR). pp 62-69 of Conference on Beneficial Uses of Thermal Discharges. Mathur, S. P. (ed.). Albany; State University of New York (1970).

From conference on beneficial uses of thermal discharges; Albany, New York, USA (17 Sep 1970). See CONF-700986-.

The use of thermal effluents for agricultural purposes is discussed. A demonstration project is described in which thermal effluents are used in the form of sprays for frost protection of fruit trees and for cooling vegetable plants during warm, dry summer months, and for the warm water irrigation of food plants. (CH)

409 WARM WATER UTILIZATION. Boersma, L. (Oregon State Univ., Corvallis). pp 74-107 of Conference on Beneficial Uses of Thermal Discharges. Mathur, S. P. (ed.). Albany; State University of New York (1970).

From conference on beneficial uses of thermal discharges; Albany, New York, USA (17 Sep 1970). See CONF-700986-.

An integrated agricultural system that utilizes thermal effluents from a power plant is described. A waste cooling cycle with a soil warming loop and an evaporative basin loop, a food processing plant, and an animal rearing facility are included. The water is recycled. The soil warming stimulates a high rate of crop production for efficient operation of the food processing plant or for animal meat production. The warm water arriving at the evaporative cooling basin accelerates the decomposition of organic wastes from the processing plant or animal rearing facility and stimulates the growth of organisms, such as algae, using these wastes as substrate. Further refinements considered are the warming of greenhouses in winter for the year-round supply of products for the processing plant; space heating and cooling of the animal enclosures; the aquaculture of algae, yeasts, or fish; and irrigation of field crops. The economic advantage of growing algae on the sewage to provide protein supplement for feeding the animals is stressed. The separate elements of the system are described and discussed in terms of energy dissipation and benefits derived from heat in the cooling water. A cost analysis is included demonstrating the economic advantages and disadvantages of the system. (CH)

410 WASTE HEAT USE IN CONTROLLED-ENVIRONMENT GREENHOUSES. Hodges, C. N.; Jensen, M. H.; Hodge, C. O. (Univ. of Arizona, Tucson). pp 108-116 of Conference on Beneficial Uses of Thermal Discharges. Mathur, S. P. (ed.). Albany; State University of New York (1970).

From conference on beneficial uses of thermal discharges; Albany, New York, USA (17 Sep 1970). See CONF-700986-.

Waste heat from diesel electric generators is utilized by the University of Arizona to desalt seawater. Crops within controlled-environment greenhouses then are irrigated with fresh water. Although blowdown water from the desalting system could be used to heat the structures during the winter, this has not been necessary in the hot areas in which the studies were made. There are two reasons for controlled-environment horticulture: to reduce the quantity of water required (i.e., if high humidity is maintained plants transpire less), and to grow vegetables where external conditions are harsh. Nineteen kinds of vegetables were harvested from such greenhouses in Puerto Peñasco, Sonora, Mexico. Yields, already high, can be increased further by enriching the enclosures with carbon dioxide, also taken from the generators. The total concept of power/water/food facilities would seem to be most applicable to desert coasts. Some aspects of the idea should be useful elsewhere, however. For example, hot industrial effluent from power generation centers could be harnessed to heat greenhouses in colder climates. (auth)

411 INDEPENDENT VIEW OF THE USE OF THERMAL POWER STATION COOLING WATER TO SUPPLEMENT INTER-REGIONAL WATER SUPPLY. Jaske, R. T.; Touhill, C. J. (Battelle Pacific Northwest Labs., Richland, WA). pp 117-131 of Conference on Beneficial Uses of Thermal Discharges. Mathur, S. P. (ed.). Albany; State University of New York (1970)

From conference on beneficial uses of thermal discharges; Albany, New York, USA (17 Sep 1970). See CONF-700986-.

Much research is under way in order to make direct utilization of the thermally warmed water from large power stations. Studies of large thermal stimulation systems have so far failed to demonstrate financial feasibility for systems growing anything but specialty crops such as fruits. The rate of heat transfer from the water surface, while relatively low, is still so high as to require large and expensive conveyance systems for distribution of warmed water. Compared to the total amount of heat that is potentially available, the amount that could be used for agricultural stimulation is relatively small and the energy is still released into the atmosphere to be a potential problem in the development of micro-climates. As an alternative or supplementary concept, the use of canals for the redistribution of water resources is suggested. This development would permit implementation of programs to create new, self-supporting metropolitan centers where present resources distribution precludes such development naturally. (auth)

412 AGRICULTURAL AND URBAN USES OF LOW-TEMPERATURE HEAT. Beall, S. E. Jr. (Oak Ridge National Lab., TN). pp 185-201 of Conference on Beneficial Uses of Thermal

Discharges. Mathur, S. P. (ed.). Albany; State University of New York (1970).

From conference on beneficial uses of thermal discharges; *Albany, New York, USA (17 Sep 1970). See CONF-700986–.*

The warm water normally discharged from condensers of steam electric generating stations is a valuable source of heat for agricultural operations. Such operations include year-round vegetable growing, broiler and egg production, and swine production *in controlled-environment structures. A system of direct* heat exchange is described, which is believed applicable for maintaining the temperature and humidity of these structures near the *optimum growth range for many plants, poultry, and swine. A* study of these applications for a 300-Mw(e) gas-cooled reactor is described. It is shown that the station cooling tower could be *replaced by 200 acres of greenhouses. By backpressuring the* turbine exhaust slightly, 100 to 120°F, the resultant exhaust steam is an economical source of heat for desalting water. How the heat from a 1000-Mw(e) station can produce 25 to 30 million gallons of water per day for irrigation or municipal consumption *is discussed. Results of a recent study of several urban applications* for heat available at higher backpressures are also presented. The heating and cooling of high-density population areas, *industrial needs, and waste water renovation make it possible to* reduce the heat rejection at the power station by an average of 60 to 70%. (auth)

413 COMBINATION URBAN-POWER SYSTEMS UTILIZING WASTE HEAT. Bell, R. A.; Cahill, W. J. Jr.; Cheifetz, A. S.; *Cowherd, G. T. Jr.; Nutant, J. A.; Wright, J. H. (Westinghouse* Electric Corp., Pittsburgh). pp 202-213 of Conference on Beneficial Uses of Thermal Discharges. Mathur, S. P. (ed.). Albany; State University of New York (1970).

From conference on beneficial uses of thermal discharges; *Albany, New York, USA (17 Sep 1970). See CONF-700986–.*

The possibilities for utilization of waste heat from power plants in urban systems were investigated. Areas of possible use surveyed included: *the use of heat available in the condenser of a* power plant to stimulate the biological activity of microorganisms in sewage sludge and increase the capacity and efficiency of the sewage treatment process; the use of the waste heat for heating aeration tanks in sewage treatment plants using a coal filtration *process; the use of the waste heat in the form of either hot water* or steam for airport fog dispersal; the use of underground piping of heated effluents for airport de[illegible] the use of heated effluents *for greenhouse heating; and the [illegible]aste heat in the form of* live steam for home heating an[illegible]nditioning. Another related study involved the injection [illegible]re oxygen into a river where aeration is needed utilizing the condenser cooling water discharge system. It was concluded that the aeration and space heating and air conditioning systems offer the most promise for methods to utilize power plant waste heat. (CH)

414 BENEFICIAL USES OF WASTE HEAT: AN EVALUATION. Garton, R. R.; Christianson, A. G. (Pacific Northwest Water Lab., Corvallis, OR). pp 214-220 of Conference on Beneficial Uses of Thermal Discharges. Mathur, S. P. (ed.). Albany; State University of New York (1970).

From conference on beneficial uses of thermal discharges; Albany, New York, USA (17 Sep 1970). See CONF-700986–.

Proposed beneficial uses of the waste heat contained in power plant cooling water are considered. It is postulated that a beneficial use must help reduce the thermal pollution problem directly or it must provide a profit to help offset the cost of cooling devices. Furthermore, the use must not result in additional pollu*tion such as that resulting from untreated organic wastes. Some* uses, such as the culture of certain fishes, are now at the pilot program, or even commerical, stage. Other uses, such as for *industrial processes, require additional research. Integrated* systems planned to produce steam as well as electrical power have been successful in special situations. In nearly all cases *additional information is needed of the overall economics of the* proposed methods. This is especially true where high quality heat is taken directly from the power plant steam cycle for another use. Only with a complete economic analysis, including cost of distribution, waste treatment, etc., can a decision be *made as to whether a beneficial use is truly beneficial in the long* run. (auth)

Chemical Effluents

Refer also to abstracts 45, 369, and 400.

415 (BNL-17478) EVALUATION OF AN AIRBORNE GAS CHROMATOGRAPH FOR LONG DISTANCE METEOROLOGICAL TRACING. *Dietz, R. N.; Cote, E. A.; Ferber, G. J. (Brookhaven* National Lab., Upton, N. Y.; National Oceanic and Atmospheric Administration, Silver Spring, Md. Air Resources Labs.). 1972. *7p. (CONF-730403-2). Dep. NTIS $3.00.*

From 165th meeting of the American Chemical Society; Dallas, Texas, USA (8 Apr 1973).

The capability of the portable SF_6 chromatograph to detect and quantitatively determine the behavior of a plume out to 100 km or *more, with a release on the order of 100 kg of SF_6, has been vali*dated. If used in conjunction with other real-time instruments for pollutants, such as the chemiluminescent NO monitor, the rate of *conversion of the pollutant could be rapidly determined as well as* the relative contribution of a source to the pollutant level at a distant location. Further development of this instrument will allow continuous real-time measurements over any desired time interval (by automatically switching chromatographic columns during backflush) thus enhancing its usefulness for meteorological tracer work. The use of SF_6 appears impractical for long-range (thousands of kilometers) tracer experiments because of the very large *release amounts required to overcome the existing SF_6 back*ground. Preliminary indications offer hope that the halocarbons (CF_2BR_2 and $C_2F_4Br_2$) tested in this experiment will prove to be feasible long-range tracers. Measurement of concentrations down to a few parts in 10^{15} may be possible by cryogenic concentration of samples in the laboratory prior to chromatographic analysis. It should also be possible to adapt the portable real-time instrument to these halocarbons by changing the column material (a prototype laboratory chromatograph was tested in this experiment). Such an airborne instrument could provide useful data to a distance of at least several hundred km as part of a long-range experiment. (auth)

INSTRUMENTATION

Radiation Detection Instruments

Refer also to abstracts 927 and 1959.

General Detectors and Monitors

Refer also to abstracts 773, 1125, and 1751–1755.

416 (AREAEE-157) PORTABLE GEOPHYSICAL GROUND SCINTILLOMETER. Huwait, M. R. A.; Hanna, N. N. (Atomic Energy Establishment, Cairo (Egypt). Engineering and Scientific Instruments Dept). 1972. 18p. Dep. NTIS (U. S. Sales Only) $3.00.

A compact and fully transistorized scintillometer primarily designed for the field surveying of radioactive raw materials is described. The main features of the instrument are its light weight (less than 1.7 kg) and low power consumption. The instrument measures radiation intensities of up to 2500 μR/hr in 4 ranges whose full scales are 50, 250, 500 and 2500 μR/hr respectively. The scintillometer circuit is supplied from a 6 V dry battery source and draws a drain current of less than 20 mA. The instrument power consumption, size, and weight are much less than similar equipment already in use and are competitive with up-to-date commercial scintillometers. Its high sensitivity makes it also suitable for carrying out contamination checks and monitoring radiation levels in radioactive laboratories. (auth)

417 (CEA-R-4372) APPARATUS FOR LOCALIZATION OF X OR γ RADIATION. Application to Organ Mapping in Nuclear Medicine. Gagelin, J. J. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Mar 1973. 128p. (In French). Dep. NTIS (U. S. Sales Only) $8.50.

Thesis.

The purpose of this study is the visualization of x-rays or gamma emitters using proportional gas counters. The use of induced electrical charges permits the association of each detected nuclear event in the gas with two electric signals on two different electrodes. These electrodes are geometrically positioned and interconnected to form a matrix, each point of this matrix being a detection cell. Thus, there is an address (x,y) for each event. An electronic channel is associated with each line or column and a coincidence logic (x,y) permits the transfer of the information to a storage and visualization unit. This multicounter is to be used in the cartography of ^{125}I tracer in the thyroid gland; its main characteristics are: sensitive area; 93 mm × 93 mm; number of cells: 961 (31 × 31); spatial resolution: 3 mm; detection efficiency: 30% for 27 keV x-rays (^{125}I); and maximum counting rate: 50,000 events/second. (auth)

418 (CEA-R-4400) CALCULATION OF THE RESPONSE OF BONNER SPHERES WITH LiI, He, AND Mn DETECTORS. Comparison with Experimental Data for LiI. Caizergues, R.; Poullot, G. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Dec 1972. 71p. (In French). Dep. NTIS (U. S. Sales Only) $5.75.

A method of calculating the response of Bonner spheres containing various kinds of detectors (LiI crystals, BF_3 counters, ^3He counters, ^{55}Mn detectors) is presented. A comparison is made between the measured and calculated responses as a function of the energy of incident neutrons on the spheres in the energy range where such measurements are possible. Calculations made for ^6Li, ^3He and ^{55}Mn detectors are presented. (auth)

419 (CNEA-323) MEASUREMENT OF THE INSTRUMENT RESPONSE FUNCTION IN THE SINGLE PHOTOELECTRON TECHNIQUE. D'Alessio, J. T.; Zampach, J.; Radichella, R.; Kesque, J. M.; Lami, H. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1972. 15p. (In Spanish). Dep. NTIS (U. S. Sales Only) $3.00.

Luminescence decay time measurements are generally performed using the single photoelectron technique. In the case of ionizing particle-induced luminescence the determination of the true decay curve requires the precise knowledge of the instrument response function R(t). The measurement of R(t) using the Cherenkov effect is described. (auth)

420 (CNEA-326) DECAY TIME MEASUREMENTS WITH TWO PHOTOMULTIPLIERS IN SINGLE PHOTOELECTRON CONDITION. Zampach, J.; D'Alessio, J. T.; Kesque, J. M. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1972. 19p. (In Spanish). Dep. NTIS (U. S. Sales Only) $3.00.

By means of the single photoelectron method we can determine the I(t) luminic function in phenomena which are within the region of the nano- and sub-nanosecond, as well as for extremely weak intensities, but with the condition of having the adequate reference pulse, which limits its possibilities. A method is proposed in which two photomultipliers are used, under single photoelectron conditions, and this makes the reference pulse unnecessary. A simple relation between the results obtained with one and two photomultipliers under single photoelectron conditions has been found, and these results have been mathematically justified for several typical cases. The practical application of the method which allows measurements of intensities within the range of 10^{-14} to 10^{-15} lumens presents no difficulties. (auth)

421 (CNEA-PRS-36/68) MULTISCALER FOR VERY LOW ACTIVITIES OF ALPHA EMITTING RADIONUCLIDES. Haehnel, C. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1972. 24p. (In Spanish). INIS.

The routine analysis of biological samples in human radiometry makes necessary the use of α radiation counters of high efficiency, low background, and the capacity to measure various samples simultaneously. The multiscalar described has the capacity of counting up to ten samples simultaneously with an efficiency of 45% and 1 c/h of background. ZnS in circular plates is used as a luminous transducer of the α radiation. The container of the substance to be measured is placed on these plates. To improve the efficiency the sample is closed with a plate of Al which increases the scattering effect. The system consists of a recorder of the counting integral as a function of time. When background counting is done for several hours, it is useful to graph this given integral function, which makes it possible to determine rapidly the existence of noise from the feed line or faults in the operation of the equipment. The recording should be a straight line; random marks can be attributed to line noise or equipment faults. (tr-auth)

422 (EGG-1183-2291) TIME RESPONSE OF AN RCA C31024 PHOTOMULTIPLIER WITH HIGH-GAIN GALLIUM PHOSPHIDE DYNODES. Stevens, J.; Hocker, L. P. (EG and G, Inc., Goleta, Calif.). Jun 1972. 10p. Dep. NTIS $4.00.

The 2-inch-diameter, five stage tube has a manufacturer's quoted anode pulse rise time (10 to 90%) of 1.3 ns for full illumination of the photocathode. NE111 and NE102 plastic scintillators and Lucite Cherenkov radiators were used with the photomultipliers to measure overall detector responses for gamma detection. The scintillator was irradiated with 50 ps bremsstrahlung bursts from the AEC/EG and G linac. The time responses of the photomultiplier and the NE111 and NE102 scintillators are shown graphically, and the time responses of the photomultiplier coupled to the scintillators are shown graphically. The FWHM of the photomultiplier was about 2.6 ns and the 10 to 90% rise time of the leading edge of the impulse response was about 1.4 ns. (WHK)

423 (IFVE-ORZ-71-105) AUTOMATIZING TREATMENT OF ACTIVATION DETECTORS. Borodin, V. E.; Gavrilov, A. S.; Bareisha, F. F.; Buchnev, V. F.; Beklemeshev, Yu. A.; Obryashchikova, L. P. (Gosudarstvennyi Komitet po Ispol'Zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1971. 16p. (In Russian). INIS.

A device is described which facilitates automation of the collection of primary information from activation detectors. The basic operating parameters, the circuitry and instrumentation are described. (tr-auth)

424 (INIS-mf-367, pp 161-166) APPLICATION OF CHERENKOV RADIATION IN MEASUREMENT OF RADIOACTIVE PHOSPHORUS. Cupak, M. (Vysoka Skola Veterinarni, Brno). [nd]. (In Czech).

A description is given of the physical conditions of the origin of the Cherenkov radiation, and of its application in measuring activity by scintillation detectors. In transparent, colorless acidic and basic solutions (to approximately 20%), no effect was found upon the measuring efficiency. The possibility is shown of increasing the measuring efficiency by increasing the refractive index of the medium and by adding a water-soluble scintillator. The determination of endogeneous phosphorus in piglets is described as an example. (INIS)

425 (INR-1422) NUMERICAL ANALYSIS OF THE TIME SPECTRA OBTAINED IN THE DELAYED COINCIDENCE MEASUREMENTS. Kaczarowski, R.; Pietrzyk, B. (Institute of Nuclear Research, Warsaw (Poland)). 1972. 74p. (In Polish). Dep. NTIS (U. S. Sales Only) $5.75.

Two computer programs are described, designed for processing of the data obtained in delayed coincidence measurements. In the first program, the sum of the exponential functions and the background of the random coincidences is fitted to the experimental data. In the second program, the theoretical function is formed by

the convolution method with the use of an experimental time-resolution curve, and is fitted to the experimental delayed coincidence curve. The programs can also be applied to the study of the radioactive decay and in the labeled-atoms method. The programs are written in the GIER ALGOL IV code. (5 figures, 4 tables) (auth)

426 (KURRI-TR-89, pp 7-14) IN-CORE SELF-POWERED NEUTRON DETECTOR. Sekiguchi, A. (Tokyo Univ.); Koizumi, Y.; Toraishi, A. 1971. (In Japanese).
In proceedings of the 3rd study meeting on neutron measurements.

Gamma-ray compensated self-powered neutron detectors having two emitters (V–Ni, Rh–Pd and Rh–Mo detectors) were developed. Each emitter has almost the same density and atomic number, but the neutron activation cross sections are very much different. By measuring the difference between each output current to the collector, the noise background was decreased to one tenth or less. The performance of detectors was investigated in the reactor core, thermal test facility in the reactor and using the cobalt-60 irradiation facility. The detectors were capable of functioning in the broader reactor power range by one decade or more than usual single emitter type and up to at least 500°C in the reactor core. (auth)

427 (KURRI-TR-89, pp 15-21) DESIGN AND PRODUCTION OF IN-CORE CHAMBER. Shiroyama, S. (Tokyo Shibaura Electric Co. Ltd., Kawasaki, Japan). 1971. (In Japanese).
In proceedings of the third study meeting on neutron measurements.

Research and development on in-core monitors for various types of reactors, such as JPDR (Japan Power Demonstration Reactor), KUR (Kyoto Univ. Reactor), JEFR (Japanese Experimental Fast Breeder Reactor) and ATR (Advanced Thermal Reactor) are summarized. For the JPDR and the KUR, ^{10}B and ^{235}U detectors were developed and irradiated to 3×10^{20} nvt. For the JMTR, special care had to be taken on the detectors because of high neutron flux in the core. For the JEFR, the considerations are on high temperature, and the trial detectors have successively operated under a temperature of 400°C. Also, the detectors for 600°C have been designed and are in the manufacturing stage. For the ATR, the detectors which have low neutron cross sections are considered. Mineral insulated cable consisting of Zr alloy and alumina was developed. Detectors made of Zr alloy are being tested and minimum reactivity loss with these detectors is expected. (auth)

428 (KURRI-TR-89, pp 22-31) IN-CORE CHAMBER TEST AT RESEARCH REACTOR INSTITUTE, KYOTO, UNIVERSITY. Kimura, Y.; Kimura, I. (Kyoto Univ.). 1971. (In Japanese).
In proceedings of the third study meeting on neutron measurements.

The characteristics of an ICM-9F in-core neutron ionization chamber made by Toshiba Electric Co. Ltd., were obtained by inserting them into the core of the Kyoto University Reactor, KUR. An excellent plateau was observed in the relation between applied voltage and ion current. The plateau did not become worse after thermal neutron irradiation of 2.4×10^{20} nvt. Direct current component of ion current was proportional to reactor power from 30 kW to 5,000 kW, while its alternate current component was proportional from 100 W to 5,000 kW. The decrease of ion current during long term irradiation agreed with calculated values in which burnup of boron-10 was evaluated. Power spectra of ion currents were measured with a band pass filter and the results showed: (1) below several tens Hz, gain increased by decreasing frequency, (2) flat or white region existed from several tens Hz to several kHz and, (3) gain decreased above several kHz which was due to time constant given by stray capacity and load resistance. Additionally, change of local neutron flux in KUR, shadowing effect of neutron flux by control rods, etc., was observed with these chambers. (auth)

429 (KURRI-TR-89, pp 32-37) THERMAL NEUTRON COUNTING MEASUREMENT IN THE HIGH-LEVEL GAMMA-RAY BACKGROUND. Wakayama, N. (Japan Atomic Energy Research Inst., Tokai). 1971. (In Japanese).
In proceedings of the third study meeting on neutron measurements.

A method and the limitations on the low-level thermal neutron flux monitoring in the high-level gamma background of the order of 10^4 to 10^5 R/h are described. Permissible maximum gamma background flux rate for the neutron counting system with a fission counter is inversely proportional to a product of the pulse shaping-width of the pulse amplifier and the gamma sensitivity of the counter which is, generally speaking, proportional to the neutron sensitivity. No erroneous counting was observed in the gamma-ray background up to 3×10^5 R/h using an ordinary fission counter of the sensitivity of 0.1 cps/nv with a pulse amplifier having 15 ns Gaussian pulse shaper. (auth)

430 (KURRI-TR-89, pp 48-63) MEASUREMENTS OF FAST NEUTRONS BY THRESHOLD DETECTORS. Kobayashi, K.; Kimura, I. (Kyoto Univ.). 1971. (In Japanese).
In proceedings of the third study meeting on neutron measurements.

A general review is given on the techniques for fast neutron flux measurement with threshold detectors. Secondly, the results about the measurement of fast neutron spectra in the KUR (Kyoto University Reactor), with several threshold detectors are shown. It has been proved that the shape of the fast neutron spectrum in the core of KUR is close to that of fission neutrons. By making use of this fission-type reactor spectrum, average cross sections for some important threshold reactions have been measured and compared with earlier values. Finally, topics about threshold detectors, expression of neutron spectrum of fission neutrons and evaluation of radiation damage caused by fast neutrons, are discussed. (auth)

431 (KURRI-TR-89, pp 71-79) MEASUREMENT OF NEUTRON FLUX IN REACTORS BY MEANS OF PARTICLE TRACKS ON DIELECTRIC MATERIALS. Hashimoto, T. (Kyoto Univ.). 1971. (In Japanese).
In proceedings of the third study meeting on neutron measurements.

An application of the fission track method using dielectric materials for the measurement of reactor neutron flux is presented. The preparation of a thin uniform fissile target was first carried out by an electrodeposition on an aluminium plate and a lacquer method with cellulose nitrate-ethyl acetate solution containing uranyl dibenzoyl methane. From the observation of the fission tracks using muscovite, it was verified that both methods gave suitable targets for this experiment. The electrodeposited U and Th-targets with muscovite and polycarbonate film as a track recording material were used for the determination of neutron flux in the various irradiation facilities of KUR (Kyoto University Reactor). The results showed a good agreement with the data obtained from Au-foil activation method. Then, a comparison of the sensitivity for the detection of neutron was performed for the (n,α) and the (n,f) reaction of each nuclide from the calculation using the known nuclear data. (auth)

432 (LBL-1346) PRELIMINARY IMAGES FROM A PROTOTYPE LIQUID XENON γ CAMERA. Zaklad, H. (California Univ., Berkeley. Lawrence Berkeley Lab.). Nov 1972. Contract W-7405-eng-48. 5p. Dep. NTIS.

A prototype liquid xenon multiwire proportional chamber was constructed and preliminary results are reported. The sensitive volume is 7 cm × 7 cm in area and 1.5 cm thick, and contains an array of 24 anode wires and 24 cathode strips. The chamber was radiated by means of a ^{203}Hg point source collimated to 2 mm at the chamber. The energy resolution was found to be 19% fwhm and the spatial resolution is estimated to be 4 mm fwhm. (WHK)

433 (ORNL-TM-4194) ENGINEERING FEASIBILITY STUDY ON AUTOMATED ATTACK-EFFECTS INFORMATION SYSTEMS. Final Report. Glass, F. M.; Rochelle, J. M.; Wilson, H. N. (Oak Ridge National Lab., Tenn.). 22 Jan 1973. Contract W-7405-eng-26. 36p. Dep. NTIS $4.00.

The Automated-Effects Information Systems-1 proposed by the Stanford Research Institute in April 1970 was studied to determine the practicability of such a system from an engineering viewpoint. At the request of the Defense Civil Preparedness Agency, ORNL prepared a preliminary design of two different models that are based on the original Basic Operating Situation (BOS) concept proposed before any work had been done on this system. Both ORNL designs will operate as dial-up systems with existing telephone networks and derive power necessary for operation directly from telephone lines. However, one is a digital system and the other is an analog system. From this study, a pressure-operated switch was developed that is automatically reset electrically and requires only a few microcoulombs of stored energy to reset it after an interrogation. A recommendation from this study is that a test model be constructed to provide a means of checking for problems that could be encountered in a dial-up system when long distance is involved. (auth)

434 (UCRL-Trans-10680) MEASUREMENT OF THE ABSOLUTE RADIOLUMINESCENCE YIELD OF LIQUID SCINTILLATORS BASED ON BENZENE AND ITS METHYLATED DERIVATIVES. Fuchs, C.; Laustriat, G. Translated from Rev. Phys. Appl.; 5: 617-623(1970). 19p. Dep. NTIS $3.00.

An experimental method for the determination of the absolute scintillation yield η is presented. Values of η obtained on deoxygenated solutions of α-NPO in aromatic solvents ($\eta = 0.020 \pm 0.002$ in the case of oxygen-free benzene) are lower than these previ-

ously reported. Radiolytic yields G_{sl} for the formation of solvent lowest excited states (G_{sl} = 0.98 for benzene) are deduced from these results. (auth)

435 IONIZATION CHAMBER FOR USE WITH A MASS SPECTROMETER. Kruger, W. P.; Turner, W. R. (to Hewlett-Packard Co.). U. S. Patent 3,723,729. 27 Mar 1973. Filed date 2 Feb 1971. 6p.

A replaceable ionization chamber for a mass spectrometer comprises an ionization region defined by two parallel perforated membranes attached to concentric tubular electrodes which are separated by the ionization region. Two filaments and two electron focusing electrodes are symmetrically disposed about the periphery of the ionization region, and sample input ports are similarly disposed about the periphery. An ion focusing electrode is mounted at the output end of the chamber. The components of the ionization chamber are supported by a plurality of conductive rods which are, in turn, supported by an insulating ring. The ionization chamber mates with a socket having a plurality of receptacles for selected ones of the conductive rods and a tubular section containing heating and cooling elements. (auth) (Official Gazette)

436 RADIO-ISOTOPE CAMERAS USING VACUUM TUBES WITH FIBEROPTIC ENDWALLS AND LUMINESCENT MEANS OF FIBEROPTIC CONSTRUCTION. Sheldon, E. E. U. S. Patent 3,719,823. 6 Mar 1973. Filed date 20 Aug 1969. 12p.

Cameras for visualization of internal organs and their pathology by means of radio-isotopes are described. The new devices are characterized by the novel combination of an image intensifying tube with a television pick-up tube and with means for rejecting the scattered gamma radiation. In addition, the new cameras are provided with novel luminescent screens which are constructed of light conducting members of a tapered shape and phosphors mounted along the sidewalls of said members. (Official Gazette)

437 APPARATUS FOR RADIO-ISOTOPE CLINICAL ANALYSIS. Britton, K. E.; Brown, N.J.G. British Patent 1,299,867. 13 Dec 1972. Filed date 18 Mar 1969. 5p.

The apparatus described has particular application to renography. It comprises first and second detectors adapted to detect radio-isotope radiation from the kidney region and from an extra-renal region, such as heat. An analogue comparator is provided for comparing the signals from the two detectors, together with display means to give a renogram corrected for blood background radiation. Two first detectors may be employed to detect radiation from the two kidney regions of a patient, and two analogue comparator means for comparing the outputs of each first detector with that of the second detector. Each detector may comprise a scintillation counter, and the display means may be a chart recorder. The whole apparatus may be mounted on a wheeled trolley. (UK)

438 RESOLUTION OF SCINTILLATION METHOD IN FAST ELECTRON INTROSCOPY. Evstigneev, V. V.; Sviryakin, D. I.; Boiko, V. I.; Adishchev, Yu. N. (Tomsk Polytechnic Inst., USSR). Defektoskopiya; No. 1, 35-41(1973). (In Russian).

The resolving ability of a scintillation electron introscope was evaluated on the basis of the distribution of the absorbed energy of fast electrons in a substance. At the optimal sensitivity (2 to 4%), attained at a depth of 0.7 to 0.9 of the extrapolated flight path, the anticipated resolving ability of an electron introscope amounted to 10 pairs per mm. (tr-auth)

439 DEVICE FOR THE DETECTION OF IONIZING RADIOACTIVE PRODUCTS IN GASES. Tamanov, E. A.; Potekhin, I. S.; Polikarpov, B. I.; Koryakin, V. I. Russian Patent 244,514. 7 Oct 1969. Filed date 23 Nov 1966. (In Russian).

A device for the detection of ionizing radioactive particles in gases and particularly for monitoring fission products in reactor effluents is described. It consists of a housing for the accumulation chamber, high-voltage and collecting electrodes, control, and a detector. In order to increase the collecting efficiency for the radioactive ions on the collecting electrodes without increasing the voltage applied to the electrode, the collecting electrode is made in the form of a grounded metallic grid and placed between two high voltage electrodes parallel to it and perpendicular to the gas flow. The high-voltage electrodes are in the form of metallic grids connected to each other and with the high-voltage source. One of the high-voltage electrodes is the ground insulated from the housing. (tr-auth)

440 EVALUATING SEMICONDUCTOR RADIATION DETECTORS. Beckett, J. Process Instrum.; 1: No. 9, 431-432 (Dec 1972).

Developments in methods for determining materials properties of Ge(Li) detectors are briefly discussed. Topics include measurement of electron drift mobility, oxygen concentration, the Fano factor, and an infrared response technique for determining defect and impurity levels in semiconductors. Also, scanning electron microscopic investigations of microcircuits are discussed. (WHK)

441 VARIATIONAL ESTIMATES OF THE DETECTOR RESPONSE CHANGE IN A FIXED SOURCE SYSTEM DUE TO CROSS-SECTION PERTURBATIONS. Hoffman, T. J. (Oak Ridge National Lab., TN). Nucl. Sci. Eng.; 50: No. 3, 300-302(1973).

An expression is derived for estimating the change in detector response due to perturbations in a fixed source system. This expression, developed with variational theory, includes a correction to first-order perturbation theory which accounts for the flux change caused by the perturbation. The derivation is extended to altered systems, and an expression is obtained which improves first-order perturbation theory by accounting for changes in the unaltered forward and adjoint fluxes. With this variational approach, all transport calculations can be performed in the unperturbed unaltered system. (auth)

442 SEMICONDUCTOR RADIATION DETECTORS. II. Kuhn, L. (Siemens AG., Erlangen, Ger.). Messtechnik; 80: 366-374(Dec 1972). (In German).

The detector types considered include p-n junction detectors obtained with the aid of a diffusion method, p-n junction detectors produced by ion implantation, and surface barrier counters. Attention is given to the dE/dx counter, the chessboard counter, a rod-like detector, and semiconductors for measuring neutrons. Questions of the neutron sensitivity of the detectors are investigated. Various types of p-i-n detectors are also discussed, taking into account Ge(Li) detectors, Si(Li) detectors, and well detectors. Possibilities regarding the employment of other substances as detector material are also explored. (IAA)

443 ELECTRONIC ASSIMILATION OF RADIATION IMAGERY DATA. Hastings, R. J. College Station, TX; Texas A and M Univ. (1972). 233p. University Microfilms Order No. 73-3538. Thesis (Ph.D).

The concept of a multi-photomultiplier tube radiation detection system that electronically displays the image of the spatial distribution of radiation interactions within a thin scintillator has been developed. Small light-conducting fibers that address the surface of the scintillator correlate a particular spatial coordinate on the surface with a particular tube. Interactions which ultimately produce tube signals coincident between two tube groups gate the visual display of the system and electronic signals corresponding to the proper components of the display "dot" of each interaction are simultaneously provided to preserve each interaction's coordinates. In addition, an electronic system to veto a coincidence signal between the groups caused by more than one interaction is incorporated into the system. A working model of the detection system was developed to reflect the concept of the detection system and its associated counting theory. The model features a NaI(Tl) scintillator disk, a $\frac{1}{16}$ inch^2 area coded by glass fibers, RCA 931A photomultiplier tubes, individual tube amplifiers, and a tube group coincidence circuitry network of AND and OR gates. A veto circuitry system is incorporated into the model which not only vetoes the eight micro-second tube group coincidences caused by more than one interaction in the scintillator but also protects acceptable coincidences caused by a single interaction from interruption by subsequent coincidences. The deflection signals providing each dot's coordinates are provided by digital-to-analogue converters, and the visual display is performed by a Tektronix 601 Storage Display Unit. The entire model was designed to be packaged in a portable assembly weighing some sixty pounds. (WHK)

444 MINIFICATION IN SCINTILLATION SCANNING. Wright, M. J. (Royal Infirmary, Derby, Eng.). Radiography; 39: No. 458, 49-50(Feb 1973).

A brief outline is presented of a scintillation scanning system which includes a mechanical transcriptor for reducing the size of the resultant image by a factor of 2 in linear dimensions. A permanent photographic record is produced by a modulated light source which travels through one half or one fifth the distance moved by the detector. The 2 to 1 reduction is used particularly for brain scanning at the Derbyshire Royal Infirmary, with the following advantages: it shortens the total time of patient exposure by allowing twice the scan speed, it saves film costs and reduces storage problems, and it has been found that the smaller prints are more easily viewed. (UK)

445 NEW $4\pi\beta$-MULTIWIRE PROPORTIONAL COUNTER FOR THE $4\pi\beta-\gamma$ COINCIDENCE MEASUREMENT. Plch, J.; Zderadicka, J.; Kokta, L. (Inst. for Research, Production, and Uses of Radioisotopes, Prague). Int. J. Appl. Radiat. Isotop.; 24: No. 2, 65-72(Feb 1973).

A new multiwire proportional counter was proposed to reduce the resolving time in the $4\pi\beta-\gamma$ coincidence method. On the basis of the calculation of the ion-number distribution and the ineffi-

ciency, the lowest height of the counter was estimated and it was shown that it cannot be considerably reduced below 10 mm. A counter with a counting volume of 60 × 60 × 10 mm in one half and with 11 wires of 20 mm diameter was tested. The counter, filled with technical-grade methane, exhibited good timing properties; the FWHM of the time spectrum was 18 nsec and the full base width was 100 nsec when new fast integrated electronics was used. A fast RC-shaping enabled a short dead time of about 2 μsec in the beta-channel to be applied. A good counting plateau, of about 400 V with the slope less than 0.2%/100 V for ^{60}Co and less than 0.1%/100 V for ^{90}Sr, was measured even at high counting rates. (auth)

446 DEVELOPMENT OF LARGE AREA HIGH PRESSURE PROPORTIONAL COUNTER CHAMBER FOR PUTTING ON A BALLOON. Kitamura, T.; Nakagawa, M.; Sakurai, H.; Takagishi, K.; Uchida, M. (Osaka Univ.). pp 218-221 of Large Balloon Symposium, 1971. Tokyo; Tokyo Univ. (1972). (In Japanese).

From large balloon symposium; Tokyo, Japan (13 Mar 1972).

Though NaI scintillation counters have mainly been used for observing astronomical x-rays with balloons, it is necessary to make large area detectors for upgrading the observation accuracy. From the viewpoint of the accuracy and efficiency, it is important to develop a proportional counter chamber using high pressure Xe gas (approximately 3 kg/cm^3), instead of crystal scintillators. The size of a counter fabricated for trial is 300 mm length × 100 mm width × 50 mm height, and the material is Al of 2.5 mm thickness. It has multi-anodes and wire cathodes. Pulse height vs energy resolution at each position is plotted when the counter is operated at 2.1 kg/cm^2 using Xe 91.2% + CH_4 8.8% gas. Though the counter fabricated is not so large, a large area can be obtained by arranging several counters together. (JA)

447 USE OF POSITION SENSITIVE DETECTORS AT ENERGIES BELOW 1 MeV. Application to a Fast Determination of the Pitch Angle Distribution of Protons Inside the Magnetosphere. Etcheto, J.; Etcheto, J.; Gendrin, R.; De La Porte Des Vaux, B. (CNET, Issy les Moulineaux, France). Nucl. Instrum. Methods; 108: No. 2, 271-277(1973).

Experimental data which were obtained in the laboratory are presented, concerning the possible use of a position sensitive detector (P.S.D.) to determine the pitch angle and energy distribution of protons inside the magnetosphere. The pitch angle α is determined by putting a slit in front of the P.S.D. Each value of α is therefore associated with a value x of the abscissa of the particle impact on the P.S.D. A division of the two impulses (one being proportional to the particle energy E, and the other to the product of x by E) gives the value of x, hence of α. It is shown that the measurement of x is improved if one takes into account the correlated noise between the two impulses, E and xE. Experimental evidence is given that with such a system, one can achieve an angular resolution of 15° for E ≈ 0.1 MeV and 2.5° for E ≈ 1 MeV. Practical application to spin stabilized satellites is also considered. (auth)

448 INVESTIGATION OF THE 0.15 S PHOSPHORESCENT COMPONENT OF NaI(Tl) AND ITS APPLICATION IN SCINTILLATION COUNTING. Koicki, S.; Koicki, A.; Ajdacic, V. (Boris Kidrich Inst. of Nuclear Research, Belgrade). Nucl. Instrum. Methods; 108: No. 2, 297-299(1973).

By means of an RCA 8850 photomultiplier tube the radioluminescence of a NaI(Tl) crystal was investigated. It was found that each fluorescent pulse (τ = 225 ns) is associated with a phosphorescent event (τ = 0.15 s) which contributes 9% to the photoelectron yield. The use of the 0.15 s phosphorescent component for the measurements of gamma-ray doses and average energies of gamma-radiation, as well as the impact of this component on scintillation counting, are discussed. (auth)

449 TECHNIQUE FOR CORRECTION OF PULSE HEIGHTS FROM THICK SILICON PARTICLE DETECTORS. Allen, K. J. F.; Klein, A. G. (Univ. of Melbourne, Parksville, Australia). Nucl. Instrum. Methods; 108: No. 2, 309-315(1973).

When detecting protons with thick silicon detectors, it is sometimes desirable to use short pulse-shaping time constants in the associated amplifier. As the charge collection time varies for electrons and holes along the proton track, an energy dependent signal loss is observed when pulse shaping and charge collection times are comparable. A method for calculating the resulting nonlinearities in the proton energy scale is presented and corrections applied to the energy calibration are compared with experiment. (auth)

450 HOLE TRAPS IN GERMANIUM CRYSTALS. Westbrook, R. D. (Oak Ridge National Lab., TN). Nucl. Instrum. Methods; 108: No. 2, 335-338(1973).

Hole trapping in lithium-drifted and high-purity germanium gamma-ray detectors is found consistently in crystals that show a certain kind of etch pit. These pits are shallow and featureless, and appear to be associated with the presence of silicon and oxygen in the melt during growth. A crystal containing as few as 10^6 of these defect sites per cm^3 will exhibit unacceptable hole trapping. No other correlation between these shallow pits and detector performance has been observed. (auth)

451 RATE OF IONIZING LOSS AND INTRINSIC RESOLUTION OF CADMIUM TELLURIDE DETECTORS. Gupta, H. V.; Chaubey, A. K. (Aligarh Muslim Univ., India). Nucl. Instrum. Methods; 108: No. 2, 339-348(1973).

The values of stopping power and most probable energy loss in CdTe have been calculated for heavy charged particles by taking into account both the shell effect and density effect corrections, in the energy interval 5 to 100,000 MeV. The fluctuations in energy loss have also been discussed and the values of fwhm as percentage of the most probable energy loss are shown graphically as a function of kinetic energy of various particles for different thicknesses of CdTe detectors. (auth)

452 FIXED LOSS FISSION DETECTOR. Banner, D. L.; Czirr, J. B. (Univ. of California, Livermore). Nucl. Instrum. Methods; 108: No. 2, 355-356(1973).

Calculations were performed with the goal of designing a fission chamber in which the fraction of fragment pairs lost by foil absorption is independent of the fragment angular distribution. (auth)

453 CRYOGENIC SCINTILLATOR-PHOTODIODE DETECTOR FOR PENETRATING CHARGED PARTICLES. Batemen, J. E.; Oezsan, F. E. (Univ. of Durham, Eng.). Nucl. Instrum. Methods; 108: No. 2, 403-407(1973).

A practicable cryostat has been developed to allow the use of a Si(Li) diode in place of a photomultiplier in a scintillation detector. A pulse height resolution of better than 0.85% fwhm has been recorded with protons of 50 MeV. The device is shown to offer the prospect of significantly better resolution than is possible with a photomultiplier, while retaining the flexibility of a scintillation detector with respect to stopping power and detector geometry. (auth)

454 LIQUID SCINTILLATION SOLUTIONS FOR PULSE-SHAPE DISCRIMINATION. Berlman, I. B.; Steingraber, O. J. (Argonne National Lab., IL). Nucl. Instrum. Methods; 108: No. 3, 587-591(1973).

A systematic study has been made of some of the processes that contribute to the scintillation pulse shape, and this knowledge has been applied to pulse-shape discriminating solutions. The results indicate that pulse-shape discrimination is enhanced by materials that have a high phosphorescence yield and large radiative lifetime. Quarternary solutions have been developed that have a larger average pulse height and better discrimination efficiency than the commercial solution NE-213. The efficiency of discrimination is generally reduced by compounds that are susceptible to excimer formation. Yet, excimer emission in certain solvents can be used to advantage to invert the normal results and to obtain pulse contours produced by electrons, that have a larger percentage of long component radiation than pulses generated by α-particles. This latter type of solution may also be useful in differentiating between the low energy β-particles and tube noise. (auth)

455 PLASTIC SCINTILLATION COUNTER WITH AN EFFECTIVE ATTENUATION LENGTH OF 25 M. Gabriele, S. A.; Giusti, P.; Massam, T.; Valenti, G.; Zichichi, A. (Cern, Geneva). Nucl. Instrum. Methods; 108: No. 3, 431-433(1973).

Using the principle of gradient activation, an improvement by an order of magnitude has been achieved in the attenuation length of plastic scintillators. (auth)

456 MECHANISM OF ALUMINUM CONTACTS IN SURFACE BARRIER DETECTORS. Andersson, L. P.; Berg, S. (Uppsala Univ.). Nucl. Instrum. Methods; 108: No. 3, 435-437(1973).

The well known aging effect of aluminum back contacts on silicon surface barrier detectors is discussed. The physical mechanism for this is discussed in terms of a proposed structural rearrangement in the interface between aluminum and silicon. The excess current due to injected minority carriers which will flow when the detector is used fully depleted (overbiased) is measured and discussed. (auth)

457 MEASUREMENTS OF RADIOACTIVE AEROSOLS USING THIN PLASTIC SCINTILLATORS. Larson, R. E. (Naval Research Lab., Washington, DC). Nucl. Instrum. Methods; 10 No. 3, 467-470(1973).

A thin plastic scintillator mounted on a photomultiplier (PM) tube is used as a detector for the beta-radioactive daughter products of radon (^{222}Rn) collected on filter papers. (auth)

458 ($\beta-\gamma$) CHAMBER FOR NUCLIDE DETERMINATION IN OFF-GAS SAMPLES. Filss, P. (Kernforschungsanlage, Juelich, Ger.). Nucl. Instrum. Methods; 108: No. 3, 471-475(1973).

Samples of radioactive off-gas are enclosed in a chamber, the walls of which are made of plastic scintillator-material. The β-spectrum as well as the γ-spectrum can be analyzed with a pulse-height-analyzer. The maximum β-energy can be determined after calibration. Coincidence between β-decays in the chamber and the γ-spectrum reduces the background and eliminates contributions from the outside of the chamber. Samples with a high content of ^{85}Kr, which are common in reprocessing reactor fuel, are well suited to be analyzed. In such samples traces of other prompt γ-emitting nuclides can be detected with an efficiency which is higher by a factor of 10^3 to 10^4 than that for ^{85}Kr. This factor overrides the lower MPC-values of these nuclides and it can be determined whether or not the off-gas may be considered as pure ^{85}Kr with regard to release limitations. (auth)

459 DATA ACQUISITION SYSTEM FOR TWO-DIMENSIONAL MEASUREMENT OF HEAVY ION REACTIONS. Helb, H. D.; Faltin, H. G.; Schlurick, T.; Voit, H. (Univ., Erlangen, Ger.). *Nucl. Instrum. Methods; 108: No. 3, 493-496(1973).*

A description is given for a data acquisition system used on line with heavy-ion reactions performed at the Erlangen EN-Tandem. With this system it is possible to measure with four counter telescopes simultaneously. Overall emphasis is on the special problems of heavy-ion reactions. (auth)

460 DETECTION SYSTEM WITH A LARGE LIQUID SCINTILLATION COUNTER FOR HIGH ENERGY NEUTRON STUDIES WITH NEUTRON GAMMA DISCRIMINATION. Nakamura, H.; Reide, F.; Yuasa, T. (Paris Univ., Orsay, France). Nucl. Instrum. Methods; 108: No. 3, 509-516(1973).

With the purpose of studying the D(p,pn)p reaction at 156 MeV, a large liquid scintillation counter (6l) has been constructed. The counter has high efficiencies for high energy neutrons (25% for 70 MeV). A neutron-gamma discrimination system, based on an unsymmetrical zero cross-over method for doubly-differentiated signals coming from a photomultiplier, could eliminate about 97% of γ-rays emitted from a Pu–Be neutron source with a discrimination energy of 1.3 MeV (in equivalent electron units). The possibility of neutron-gamma discrimination has been tested in the range from 3 MeV to 120 MeV (in equivalent electron energy). (auth)

461 TEMPERATURE COMPENSATED SINGLE CHANNEL ANALYZER FOR MONITORING PURPOSES. Hadis, R. (Comision Nacional de Energia Atomica, Buenos Aires). Nucl. Instrum. Methods; 108: No. 3, 533-539(1973).

The design of a single channel analyzer to be used as a monitor of reactor fission products is presented. Emphasis is placed on reliability through circuit simplification and minimum number of components compatible with an acceptable level of accuracy. The circuit comprises six integrated circuits and associated discrete components. Integral and differential nonlinearity attainable with an elementary window discriminator is evaluated, and conditions for its proper triggering are discussed. The temperature behavior of a TTL driven counting rate meter is shown to be independent of the counting rate and of the design of the array of diode pumps. The temperature compensation required for this section is calculated and implemented using a simple circuit arrangement. The single channel analyzer has been designed to be used as a monitor of fission products present in the water cooling circuit of the RA-3 reactor. (auth)

462 COMPENSATION FOR GAIN VARIATION WITH RATE IN A NaI(Tl) SCINTILLATION COUNTER. Birk, M.; Eisen, Y.; Vager, Z. (Weizmann Inst. of Science, Rehovot, Israel). Nucl. Instrum. Methods; 108: No. 3, 611-612(1973).

Compensation for gain increase with rate in a NaI(Tl) scintillation counter was achieved by using dc negative feedback from the collector of the photomultiplier tube to its dynodes' resistor chain. A 16% gain variation was reduced to 1% by using a nonlinear collector load consisting of resistors paralleled by Zener diodes. (auth)

463 Gd-LOADED PLASTIC SCINTILLATOR. Czirr, J. B. (Univ. of California, Livermore). Nucl. Instrum. Methods; 108: No. 3, 613(1973).

A commercially available plastic scintillator has been loaded with sufficient Gd to permit detection of 1-MeV neutrons with greater than 90% efficiency. (auth)

464 *DETECTION SYSTEM FOR HEAVY AND SUPERHEAVY* COSMIC RAY NUCLEI. Gold, R.; Porges, K. G. (to United States Atomic Energy Commission). U. S. Patent 3,717,767. 20 Feb 1973. Filed date 2 Nov 1971. 6p.

A detection system using a pair of Cherenkov detectors of different refractive indices is used for the observation of heavy and superheavy realitivistic cosmic ray nuclei. Hodoscopes are used in conjunction with the Cherenkov detectors to determine the path of the nuclei through the Cherenkov detectors. The velocity and charge of the cosmic ray nuclei are determined from conventional pulse height analysis. (Official Gazette)

465 CHARACTERISTICS OF A PULSE-SHAPE DISCRIMINATOR WITH LOW-LYING THRESHOLD. Tagesen, S. Oesterr. Akad. Wiss. Math.-Naturwiss. Kl., Anz.; 108: 77-83(1971). (In German).

The development of a pulse-shape discriminator with low threshold is described for neutron–gamma radiation. The arrangement is depicted in a block diagram. Above a recoil proton energy of 1 MeV, the separation of neutron and gamma events is very good. Between 0.2 and 1 MeV, a small number of gamma events is still registered, while neutron events are recorded almost completely. The design thus significantly enhances the sensitivity for low-energy neutrons. (HBG)

466 MEASURING CHERENKOV RADIATION PRODUCED BY CHARGED PARTICLES PASSING THROUGH A GAS AS INDICATIVE OF THE ENERGY OF THE CHARGED PARTICLES. von Arx, A.; Kuphal, K. (to Aktiengesellschaft Brown, Boveri and Cie). U. S. Patent 3,718,818. 27 Feb 1973. Priority Date 29 Sep 1969, Switzerland. 4p.

A device for determining the energy of electrically charged particles emanating from a particle accelerator such as a betatron used for radiation therapy is described. The Cherenkov radiation is produced in a gas target. First and second adjacently located detectors are disposed in the path of Cherenkov radiation, both of these detectors being exposed to the same dispersed and secondary particle radiation but one detector being shielded from the direct Cherenkov radiation. The respective outputs from the detectors are led through amplifiers whose amplification factors are adjustable into a difference meter, and the output of the difference meter is applied to a measuring instrument. (Official Gazette)

Radiation Dosimeters

467 (AERE-R-6156) *FILM DOSIMETRY WITH THE* AERE/RPS FILM HOLDER. A Reassessment Using the "Estar" Film. Burt, A. K.; Smith, J. W. (Atomic Energy Research Establishment, Harwell (England)). Dec 1972. 20p. Dep. NTIS (U. S. Sales Only) $3.00. UK 50 pence.

Kodak RM film has a polyester base ("Estar") replacing the slightly thicker cellulose triacetate base. The performance of this film in the AERE/RPS holder has been assessed for its response to beta, X, and gamma radiation and the opportunity was taken to reassess the triacetate based film with better known X-ray sources. It is shown that the present formula for assessing the photon dose is acceptable for routine personnel film dosimetry when applied to the combination of AERE/RPS holder and Estar based film. However, in the case of some monochromatic X-rays, a correcting factor will give improved accuracy. (auth)

468 (CEA-CONF-2189) MEASUREMENT OF THE POWERS OF RADIOACTIVE β SOURCES BETWEEN 1 AND 300 WATTS. Vagner, J. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1972. 10p. (In French). (CONF-720573-2). Dep. NTIS (U. S. Sales Only) $3.00.

From fourth national meeting on calorimetry and differential thermal analysis; Paris, France (4 May 1972).

Three different types of calorimeters are presented. They are intended for use inside a hot cell used for the remote handling of highly radioactive sources ($^{90}Sr + ^{90}Y$, ^{147}Pm or other β emitters). Thermocouples are used to measure the temperature rise of a metallic casing which contains and completely encloses the source. Circulating water is used to maintain a constant temperature. The heating due to the source is compared to that due to a simulating source heated by the Joule effect. The greatest uncertainty arises from fluctuations in the temperature of the water; this uncertainty is, however, only troublesome for low powers. (FR)

469 (CEA-R-4434) IONOMETRIC DETERMINATION OF A REFERENCE ABSORBED DOSE IN AIR USING A CAVITY CHAMBER. Sklavenitis, L.; Simoen, J. P.; Troesch, G.; Pages, L.; Tabot, L. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Mar 1973. 42p. (In French). Dep. NTIS (U. S. Sales Only) $4.25.

For normalization of dosimeter calibration and for radiation protection purposes, the absorbed dose within a small air volume surrounded by an air thickness of 0.3 g/cm^{-2} has been adopted as a reference in photon dosimetry. The measurement of this reference absorbed dose is done with an ionization chamber of 5 cm^3 of volume having walls 0.3 g/cm^{-2} thick made of a mixture of teflon and carbon. The associated electronic device allows very precise measurements to be automatically repeated. The

assembly, ionization chamber-measuring device, can measure directly absorbed dose rates ranging from 0.1 to several thousands of rad/h^{-1}, with an error of the order of 1% for photons of energy between 40 keV and 1.3 MeV. Lower energies and dose rates can also be measured with less accuracy. In that case a calibration correction factor is needed. Besides its utilization for calibration of radiation dosimeters, the ionization chamber is suitable for calibration of photon beams of large or poorly known energy range as, for example, those issued from x-ray tubes or teletherapy radiation sources. (auth)

470 (CONF-721203-10) INTERCOMPARISONS OF NEUTRON MONITORS UNDER CONDITIONS OF SIMULATED NUCLEAR ACCIDENTS. Haywood, F. F. (Oak Ridge National Lab., Tenn.). 1972. 16p. Dep. NTIS.

From symposium on neutron monitoring for radiation protection purposes; Vienna, Austria (11 Dec 1972).

A continuing dosimetry intercomparison study was started at Oak Ridge National Laboratory in 1965 because of a need at several national laboratories to examine existing methods and procedures for interpreting monitoring data from acute personnel exposures. The specific objective of this program is to provide an experimental arrangement which will allow dosimetrists to compare the response of their monitoring systems to those which have been widely accepted. Since soon after its inception, the program has been open to dosimetrists from throughout the world. A facility is provided whereby pulsed radiation fields are produced to simulate nuclear accident conditions, and a staff of experimental physicists is on hand for overall guidance and technical support. Since the early phases of this program, improvements have been made in the facilities, giving rise to more uniform radiation fields, and simultaneous advances have been made in monitoring systems. Much of the success of these studies is due to the earlier development of standard diagnostic tools, such as the absolute proportional counter and neutron energy threshold detectors, and to the more recent improvements in high speed digital computers and radiation transport calculations. A brief history of the existing program is presented along with an account of some progress which has been made both nationally and internationally in the field of accident monitoring. Typical results are given, showing comparisons of neutron dose and fluence, as well as gamma-ray dose for a variety of detector systems. In addition, the types of neutron monitors used throughout the program, as well as current trends in monitoring, are reviewed. (auth)

471 (KFK-1635) NUCLEAR ACCIDENT DOSIMETRY MEASUREMENTS AT THE SECOND I.A.E.A. INTERCOMPARISON AT OAK RIDGE, USA, MAY 1971. Piesch, E. (Kernforschungszentrum, Karlsruhe (West Germany)). Dec 1972. 21p. Dep. NTIS (U. S. Sales Only).

Teams from several countries participated in an international intercomparison of nuclear accident dosimeter systems, organized by the I.A.E.A., in which criticality dosimeters were exposed to mixed pulses of neutron and gamma radiation from the Health Physics Research Reactor at Oak Ridge. The final results of the measurements made with the personnel dosimeter system of the Karlsruhe Nuclear Research Centre are given. The dose assessment both in free air and on phantoms is based on standard interpretation of the routine personnel dosimeter, the phosphate glass dosimeter, and threshold detectors. During the experiment the dosimetric properties of a belt of polycarbonate foil were studied using the neutron-induced recoils and (n,α) reaction in the plastic foil for a detection of neutrons >1 MeV. The effect of fission neutrons on the reading of gamma dosimeters was studied on different phosphate glass dosimeters and LiF dosimeters. (auth)

472 (KURRI-TR-89, pp 64-70) NEUTRON DOSIMETRY WITH THE SOLID STATE TRACK DETECTOR. Tsuruta, T. (Kyoto Univ.). 1971. (In Japanese).

In proceedings of the 3rd study meeting on neutron measurements.

The properties of several types of solid state nuclear track detectors for neutron dosimetry have been investigated. The detectors were irradiated with fast neutrons (2.5 MeV, 14 MeV) and a count was made of the number of etch-pits on the surfaces of irradiated detectors after etching with suitable chemical reagents. The first type of the detectors used in these experiments was phosphate glass or natural mica, on which the electrodeposition thin film of natural uranium or thorium on gold foil was contacted. The experiment proved that a good agreement exists between the expected number of fissions and the number of etch-pits. The second type was the glass or mica or plastics, on which the foil of the fissionable material much thicker than the range of the fission fragment was contacted. It has been shown that the sensitivity is explained by the range of the fission fragment in the fissionable material. The third type was the phosphate glass, in which natural uranium and/or thorium was doped. It was found that the number of etch-pits and sensitivity increase with the etching time. Broad energy range neutron dosimetry in mixed radiation fields with this solid state fission track detector was discussed. The fourth type was plastics, such as polycarbonate, cellulose nitrate and cellulose acetate. It may be inferred that the etch-pits observed in polycarbonate might have developed at the site of radiation damage caused by the recoil carbon and oxygen due to fast neutron irradiation. (auth)

473 (REG/G-8-3(2-73)) FILM BADGE PERFORMANCE CRITERIA. (Directorate of Regulatory Standards (AEC), Washington, D. C.). 2 Feb 1973. 2p. DRS, Washington, DC Free.

474 (REG/G-8-4(2-73)) DIRECT-READING AND INDIRECT READING POCKET DOSIMETERS. (Directorate of Regulatory Standards (AEC), Washington, D. C.). 26 Feb 1973. 2p. DRS, Washington, DC Free.

475 (TUBIK-27) EXPERIMENTAL EXERCISES IN NUCLEAR RADIATION MEASUREMENT TECHNIQUES. Wegener, H. (Technische Universitaet, Berlin (West Germany). Institut fuer Kerntechnik). Jan 1973. 179p. (In German). Dep. NTIS (U. S. Sales Only) $11.00.

The practical exercises comprise experiments which were developed for students at the Technical University of Berlin. Detectors and dosimeters for the measurement of alpha, beta, and gamma radiation are discussed. (HBG)

476 ELECTROMETRIC EQUIPMENT FOR THE AUTOMATIC MEASUREMENT OF SMALL DC CURRENTS FROM A REFERENCE IONIZATION CHAMBER. Roulet, R. (CEN, Grenoble, France). *Rayonnements Ionis. Tech. Mes. Prot.; No. 4, 28-45(Oct 1972).* (In French).

The results of measurements made with a calibrated current generator (Keithley type) and a 5 cm^3 Teflon-carbon ionization chamber with radiation from a ^{60}Co source are presented. The results of long duration reproducibility measurements are given together with an intercomparison of exposure calculations made using a calibrated Victoreen chamber. (FR)

477 DIGITAL RADIATION DOSIMETER WITH IMPROVED INTEGRATING PULSE IONIZATION CHAMBER. Borkowski, C. J.; Rochelle, J. M. (to United States Atomic Energy Commission). U. S. Patent 3,712,983. 23 Jan 1973. Filed Date 9 Nov 1971. 8p.

An improved digital radiation dosimeter of the oscillating ionization chamber type including a gas diode connected in series with the chamber anode having improved operation and miniaturization of the detector chamber is described. This is made possible by a circuit that adds strobe pulses to the normal DC chamber bias voltage so as to allow the gas diode to discharge even though the active chamber volume is not large enough to produce sufficient diode bias current at low radiation exposure rates. (Official Gazette)

478 NEW TECHNIQUES FOR DOSIMETRY: ETCH PIT METHOD. 1. ITS HISTORY, FUNDAMENTALS, AND FUTURE. Sakanoue, M. (Kanazawa Univ., Japan). Hoken Butsuri; 7: No. 2, 93-98(Jun 1972). (In Japanese).

Since solid state track detectors have advantages which cannot be substituted by others, e.g., they are simple and detectable to fine structure, and are easily available, application has rapidly developed to many fields. The application to dosimetry in personnel and environmental control because of advantages of good selectivity for each particle beam and less background influence is discussed. Also, its use for the component analysis of heavy ions and in the search for super-heavy elements in cosmic rays is discussed. (JA)

479 NEW TECHNIQUES FOR DOSIMETRY: ETCH PIT METHOD. 2. NEUTRON DOSIMETRY WITH SOLID STATE TRACK DETECTOR. Tsuruta, T. (Kyoto Univ., Kumatori, Japan). Hoken Butsuri; 7: No. 2, 99-103(Jun 1972). (In Japanese).

The use of solid state track detectors with fission, recoil, and (n,α) reactions for neutron dosimetry is discussed. Applications include neutron flux measurements in reactors and near the target of 14-MeV neutron generators. Commonly used plastics are discussed. (WHK)

480 ALBEDO-NEUTRON DOSIMETERS (15 JAN 1973) (ENGINEERING MATERIALS). (Los Alamos Scientific Lab., N. Mex). (CAPE-2325).

1 Drawing.

A drawing of an albedo-neutron dosimeter which is small (1¼ by ¾ by ⅜ in.) and can be worn by taping it to the bottom of the existing film badge is described. It can be made in a workshop from cadmium and polyethylene sheets without special equipment or training in about one hour at a materials cost of about 25 cents

(excluding the TLD's). The dosimeter was designed to use ^{6}Li and ^{7}Li TLD chips although other types of ^{6}Li and ^{7}Li TLD's could be used. The neutron dose is determined by subtracting the ^{7}Li reading from the ^{6}Li reading and applying the appropriate calibration factor. The thermal-neutron sensitivity of the dosimeter is equal to the sensitivity for fast neutrons of about 1 MeV energy. The dosimeters were designed from the results obtained in studies made to determine the design features of a dosimeter. Reports of this work have been published as LA-4832, "Factors Affecting the Design of Albedo-Neutron Dosimeters Containing Lithium Fluoride Thermoluminescent Dosimeters," by Dale E. Hankins and in a paper presented at the IAEA Symposium on Neutron Monitoring for Radiation Protection Purposes in Vienna entitled "Design of Albedo-Neutron Dosimeters" by Dale E. Hankins, December 1972. (auth)

481 FLUENCE AND DOSE EQUIVALENT DETERMINATION IN A NEUTRON FIELD BY MEANS OF MODERATING SPHERES CONTAINING FISSION TRACK RECORDERS. Mijnheer, B. J.; Pauw, H.; Van Herk, G. Jr.; Aten, A. H. W. Jr. (Institut voor Kernphysisch Onderzoek, Amsterdam). *Health Phys.; 24:* No. 4, 423-427 (Apr 1973).

A description is given of the determination of neutron fluence and dose equivalent by means of registration of tracks in plastic foils from thin layers of fissile material surrounded by moderator spheres. (auth)

Nuclear Spectroscopic Instrumentation

Refer also to abstract 1518.

482 (ANL-Trans-941) PRECISE MEASUREMENT OF THE ABSOLUTE γ-INTENSITY OF LOW-ENERGY TRANSITIONS IN (n,γ)-REACTIONS AND DURING RADIOACTIVE DECAY BY MEANS OF A CRYSTAL SPECTROMETER. Neumann, H. A. Translated from Z. Naturforsch.; 21a: 1328-1343(1966). 31p. Dep. NTIS $3.75.

A direct and an indirect method for accurate measurement of absolute intensities of low-energy γ rays from neutron capture and radioactive decay by means of a crystal spectrometer is described. The 478-keV peak of ^{7}Li (target ^{10}B) is used in the direct method, while the 412-keV peak of ^{198}Hg (target Au) is used in the indirect method. In addition the intensity calibration of the crystal spectrometer used in FRM (Munich Research Reactor), determination of the neutron capture rate and corrections for γ and neutron self absorption are discussed in some detail. Absolute γ intensities per neutron capture or decay were determined for a number of strong low-energy γ transitions in ^{104}Rh, ^{114}Cd, ^{150}Sm, ^{153}Sm, ^{152}Eu, ^{153}Eu, ^{154}Eu, ^{156}Gd, ^{158}Gd, ^{162}Dy, ^{163}Dy, ^{164}Dy, ^{165}Dy, ^{165}Ho, ^{166}Ho, and ^{166}Er. An accuracy of 2% was obtained in the most favorable cases. (6 figures, 12 tables) (auth)

483 (CEA-R-4393) NEUTRON SPECTROMETRY USING THE $^{6}Li(n,\alpha)^{3}H$ REACTION AND SURFACE BARRIER DETECTORS (KERMA COMPUTATIONS IN NEUTRON IRRADIATED TISSUES). *Laguerre, R. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Mar 1973.* 116p. (In French). Dep. NTIS (U. S. Sales Only) $8.00.

Thesis. Submitted to Toulouse Univ. (France).

A spectrometer using the $^{6}Li(n,\alpha)^{3}H$ reaction and surface barrier detectors has been developed for spectral analysis of fast and intermediate neutrons near critical assemblies. Main items include theoretical calculations, and experimental determinations of the geometrical efficiency factor versus incident neutron energy; a mathematical model giving experimental results versus spectrometer resolution; HARMONIE reactor spectra-comparison with other methods; and kerma computations in neutron-irradiated biological samples. (auth)

484 (CNEA-328) NUMERICAL SIMULATION FOR AUTOMATIC SPECTRAL ANALYSIS. Diaz Romero, A. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1972. 8p. (In Spanish). Dep. NTIS (U. S. Sales Only) $3.00.

A method has been developed for evaluating the proficiency of the various available programs for the automatic analysis of those spectra whose peaks can be fitted by gaussians. The method consists in the simulation of spectra by means of combinations of gaussians of different areas, separated by variable distances and grouped into a variety of modes. By analyzing the simulated spectra with the programs to be tested, it is possible, by systematizing errors, to establish a merit factor that permits to decide which is the program with the highest precision in the definition of the parameters of the peaks—area, position, and width—and having, at the same time, the greatest resolving power. (auth)

485 (CONF-721010-63) PRECISE GE(LI) SPECTROMETRY AT HIGH AND VARIABLE COUNTING RATE. Adams, F.; Hoste, J.; Bartosek, J.; Masek, J. (Ghent Rijksuniversiteit (Belgium). Institutt Voor Kernwetenschappen; Brno Univ. (Czechoslovakia)). 1972. 16p. Dep. NTIS (U. S. Sales Only) $3.00.

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

Circuits are presented for the accurate determination and automatic correction of counting losses occurring in gamma spectrometry. The circuit can even be used in the case of time dependent counting rates such as those encountered when measuring short lived radioisotopes. Experimental proof is given demonstrating that accurate quantitative measurements can be made using these circuits. Count rate losses of less than 1.5% occur for count rates up to 20,000 counts per second. (France)

486 (CONF-730302-10) GAMMA-RAY SPECTRUM CATALOGUE: A USER DATA FILE. Heath, R. L. (Aerojet Nuclear Co., Idaho Falls, Idaho). [nd]. 14p. Dep. NTIS $3.00.

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973).

Instrumentation, techniques, and radioisotope production used for the compilation of the gamma-ray spectrum catalogue are discussed. Characteristics of Ge(Li) and Si(Li) detectors used for the catalogue data are tabulated, and the facilities used to produce the isotopic samples are listed. Typical data from the catalogue are presented and discussed. (WHK)

487 (HASL-267) THIRTY ONE GROUP RESPONSE MATRICES FOR THE MULTISPHERE NEUTRON SPECTROMETER OVER THE ENERGY RANGE THERMAL TO 400 MeV. *Sanna, R. S. (Health and Safety Lab. (AEC), New York). Mar* 1973. 43p. Dep. NTIS $4.00.

The response of the multisphere ^{6}LiI neutron spectrometer system over the energy range from thermal to 400 MeV was calculated using one-dimensional, discrete ordinates transport codes. Provision was made to account for various types and sizes of absorbers and various density moderators. (auth)

488 (JEN-249) NEUTRON SPECTROSCOPY WITH ORGANIC SCINTILLATORS. Butragueno Casado, J. L. (Junta de Energia Nuclear, Madrid (Spain)). 1972. 66p. (In Spanish). Dep. NTIS (U. S. Sales Only) $5.50.

A fast neutron spectrometer using a stilbene crystal as detector with pulse shape discrimination (P.S.D.) to reject gamma background is described. The experimental procedure involves the P.S.D., the measurements to calibrate the spectrometer, and the corrections for several factors, mainly the non-linear response of the stilbene. Results of the measurements with the reaction $^{2}D(d,n)^{3}He$, and with an Am-Be neutron source are presented. Also, the measurement of the spectrum of the fast reactor CORAL-I is presented. (auth)

489 (JINR-P13-6925) PULSE GENERATOR OF HIGH STABILITY AMPLITUDES. Semenov, B. Yu.; Lomakin, O. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

A generator is described for producing pulses of high-stability (instability of 10^{-4}) and fine control (1 to 10 V) amplitudes. Two modifications of the device are considered: C51-for the generation of trapezoidal pulses and C57-for square ones. The generator can be applied to adjustment, electronic control, or directly to physical experiments, e.g., as generator of the reference pulse for the servo-stabilization system of an amplitude spectrometer with a Ge(Li) detector. (auth)

490 (JINR-P13-6944) CHARGE-SENSITIVE PREAMPLIFIER WITH DRAIN FEEDBACK. Andert, K.; Banifatov, A. E.; Gabriel, F.; Kalinin, A. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 12p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Charge-sensitive preamplifiers without feedback resistors at the gate of a field transistor are considered. A circuit of the preamplifier with drain feedback is given. An energy resolution of 370 eV on a line of 17 keV was obtained from ^{241}Am with the help of a Si(Li) detector (3.7 mm in diameter, the sensitive layer thickness being 3 mm). (auth)

491 (KURRI-TR-89, pp 38-47) SANDWICH-FOIL METHOD. Nakazawa, M. (Tokyo Univ.). 1971. (In Japanese).

In proceedings of the 3rd study meeting on neutron measurements.

The resonance sandwich-foil method is suited for spectrum measurements in fast reactors or assemblies because of the reduced contributions of 1/v-captures and higher energy resonance captures. There are, however, several difficulties in quantitative estimations of measured spectra; uncertainties of resonance-integral values, unfolding methods including the higher resonance contributions, etc. A practical unfolding method was developed, which is based on the spectrum representations with

two parameters; one is a spectrum-index in the energy region of main resonances, the other is a spectrum-index in the energy region of higher resonances, that is defined for every resonance foil. This approach has been verified experimentally through the spectrum measurements in the Fast Critical Assembly (FCA in JAERI) core number V-1. (auth)

492 (KURRI-TR-89, pp 80-86) FAST NEUTRON SPECTRUM MEASUREMENT WITH PROTON RECOIL PROPORTIONAL COUNTER. Ichimori, T.; Obu, M.; Shirakata, K. (Japan Atomic Energy Research Inst., Tokai). 1971. (In Japanese).

In proceedings of the 3rd study meeting on neutron measurements.

The characteristics of a small proportional counter were studied. Field adjusting tubes of hypodermic needles are not adequate for use in the low gas multiplication, being compared with insulated ceramic ones. The saturation in gas multiplication begins to occur for about 2×10^5 electrons collected by anode wire per pulse in small counters (15 to 20 mm diameter) from the behavior of monochromatic neutron responses. Neutron-gamma discrimination is possible to eliminate about 90% of total gamma events in the energy of about 5 keV by electronic devices. It is necessary to use a lead shield at spectrum measurement in the lower energy region. In the response function of a counter measured experimentally, sensitive volume is dependent on the energy of incident neutrons by currents from dead regions. Therefore, integration of the function, expressed as probabilities, is not normalized to unity. (auth)

493 (KURRI-TR-89, pp 87-93) PULSE SHAPE DISCRIMINATION IN A PROPORTIONAL COUNTER AND ITS APPLICATIONS. Mizuho, M. (Japan Atomic Energy Research Inst., Tokyo). 1971. (In Japanese).

In proceedings of the 3rd study meeting on neutron measurements.

A method of pulse shape discrimination in a proportional counter, in conjunction with a rise time-to-amplitude converter (RAC), was applied to the n–γ discrimination and the electronic collimation. Neutrons and gamma rays give pulses of different rise times respectively, and the difference is especially clear in the case where the gas pressure is so high that the proton range is very short (1 to 2 mm). The difference in the rise time was analyzed with a RAC and applied to the n–γ discrimination. On the other hand, ionizing particles parallel to the anode wire in a proportional counter give rapid rising pulses. Alternatively, the others give slow rising pulses. This is applicable to the electronic collimation of ionizing particles. Collimating properties were studied using a ^{241}Am alpha source. This collimating scheme introduced a neutron spectrometer of new type which is to be classified as a thick radiator-multihole collimator type. (auth)

494 (KURRI-TR-89, pp 94-100) RESPONSE OF A Kr-FILLED ^{3}He PROPORTIONAL COUNTER. Shirakata, K.; Mukaiyama, T.; Iijima, T. (Japan Atomic Energy Research Inst., Tokai). 1971. (In Japanese).

In proceedings of the 3rd study meeting on neutron measurements.

Measurement of neutron spectrum with a ^{3}He proportional counter used in fast critical assembly "FCA" in JAERI is limited to the energy range from about 20 keV to 2 MeV. The upper limit of the applicable range is determined mainly by an increase of wall effect of the counter in the higher energy region. A new ^{3}He counter filled with Kr gas is introduced to extend the upper limit of the applicable range. Responses of the counter to monoenergetic neutrons are obtained, and it is applied to the measurement of neutron spectrum in FCA assembly. As a result, neutron spectra up to 5 MeV are measured with a good agreement to a calculated result. (auth)

495 (KURRI-TR-89, pp 101-107) INTERMEDIATE NEUTRON SPECTRUM MEASUREMENT WITH 1/v FILTER DIFFERENCE METHOD. Nanjo, T. (Kyoto Univ.). 1971. (In Japanese).

In proceedings of the 3rd study meeting on neutron measurements.

An integral type measurement on an intermediate neutron spectral system was performed using the 1/v-filter difference method. The count rates set was unfolded into the neutron energy spectrum with the methods of the least-squares expansion and the count rate iteration. Reasonable results were obtained by both methods, and were compared with the results of the TOF measurement and of the theoretical calculations. (auth)

496 (KURRI-TR-89, pp 108-122) NEUTRON DETECTORS FOR TIME-OF-FLIGHT ANALYSIS. Kimura, I.; Yamamoto, S. (Kyoto Univ.). 1971. (In Japanese).

In proceedings of the 3rd study meeting on neutron measurements.

The status of neutron detectors for neutron time-of-flight analysis is briefly surveyed. The characteristics of ^{6}Li and ^{7}Li glass scintillation counters (glasses of 5 inches in diameter and a half inch thick plus EMI-9618R/Philips XP-1040) were tested. It was seen that: (1) the energy resolution of thermal neutron peak became 16 to 18% (fwhm) for NE 908/NE 912 and EMI-9618R with one or two quartz plates (1.65 cm thick) as a light guide, (2) the response of a ^{7}Li glass scintillation counter (NE 913) to gamma-rays was similar to that of a ^{6}Li counter, however the sensitivity of the ^{7}Li glass to neutrons was much lower than that of the ^{6}Li glass, (3) the energy resolution of NE 912 to fast neutrons was much broader than that to thermal neutrons, and (4) time resolution of NE 912 plus EMI-9618R with a fast discriminator became 13.4 ns. The advantages of using a ^{7}Li glass scintillation counter for determining background in time-of-flight experiments are discussed. Some typical results with the ^{6}Li glass scintillation counter are shown. (auth)

497 (PRNC-160) COMPUTER AIDED DECOMPOSITION OF GAMMA SPECTRA EMITTED BY CERTAIN RADIOACTIVE NUCLIDES. Gileadi, A. E.; Kuppusamy, N. (Puerto Rico Nuclear Center, Mayaguez). Jan 1973. Contract AT(40-1)-1833. 80p. Dep. NTIS $6.00.

Thesis. Submitted by N. Kuppusamy to Puerto Rico Univ., Mayaguez.

A computer code PRGA, written in FORTRAN IV, has been developed in order to perform decomposition of certain gamma spectra obtained by means of Ge(Li) diode equipped with a multichannel data acquisition system. The code uses spectra of the individual standards and those of the mixtures as input data and calculates the mixing factors pertinent to each component, using linear least squares fit techniques. PRGA is presently operative on both the IBM-360/40 and the PDP-DEC-10 computers at the Computer Center of the University of Puerto Rico, Mayaguez Campus. The code includes corrections designed to account for deadtime losses, natural and spectral background, decay, and counting statistics. Using source mixtures with premeasured mixing factors specially prepared for the purpose of comparisons, it was found that the premeasured and PRGA computed mixing factors are in satisfactory agreement. (auth)

498 (PTB-FMRB-44) PROCEDURE FOR IMPROVING THE ENERGY RESOLUTION IN NUCLEAR RADIATION SPECTROSCOPY WITH A SEMICONDUCTOR DETECTOR AT HIGH PULSE RATES. Schuster, H. J. (Physikalisch-Technische Bundesanstalt, Brunswick (West Germany)). Feb 1973. 112p. (In German). Dep. NTIS (U. S. Sales Only) $7.75.

The optimum filter time constants for common filter types used in semiconductor spectrometers were determined so that the signal-to-noise ratio becomes maximum even under consideration of the pulse pileup. Also, the problem of optimizing filters according to the best energy resolution, i.e., smallest fwhm, is discussed. It is seen that the signal-to-noise ratio and the energy resolution can be improved by new pulse dependent filters whose transmission characteristics are not the same for each voltage step but are permanently adjusted to the time intervals between the voltage steps. This optimum filter can probably not be realized and practicable approximations are proposed. (WHK)

499 (RT/EL-(72)10) CALIBRATION METHOD OF A Ge(Li) SPECTROMETER USING A THREE OUTPUTS PULSER. Cervellati, R.; Giannini, M.; Zagara, M. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 20 Dec 1972. 42p. Dep. NTIS (U. S. Sales Only) $4.25.

A new method for accurate calibration of a Ge(Li) gamma spectrometer is described. The method is based on a mercury-relay pulser from which pulses of three amplitudes are cyclically obtained, and on a digital spectrum stabilizer which keeps at fixed points on the channel scale the peaks corresponding to 2 of the 3 pulser amplitudes. The method overcomes the well known drawback on any calibration using a pulser due to instabilities of the electronics, here including the pulser itself. The instability of the centroid of a gamma peak is lowered to less than $\pm 15 \times 10^{-3}$ channel over the range of 4,000 channels. The use of two accurate energy standards allows a point by point calibration of the channel scale in terms of energy. The error in the calibration can be made as low as a few eV, typically ±20 eV at 400 keV. (auth)

500 (SGAE-2076) OBSERVATION OF SIMILARITY IN THREE AXES NEUTRON SPECTROMETER ARRANGEMENT. Quittner, G. (Oesterreichische Studiengesellschaft Fuer Atomenergie G. M. B. H., Seibersdorf, Institut Fuer Physik). Dec 1972. 10p. (In German). (SGAE-PH-135/72). Dep. NTIS (U. S. Sales Only) $3.00.

The choice of spectrometer configurations for inelastic neutron scattering giving a good compromise between intensity and resolution depends on a choice of about 15 disposable parameters. The

choice of a typical or reference value for the neutron wavenumber as well as for the angular divergences of collimators and crystals is considered. For simplicity, only similar spectrometer configurations are compared. The dependence of counting rate versus the characteristic wavenumber for fixed momentum resolution is given; under the assumption of a Maxwellian neutron source smaller wavenumbers are more advantageous. This applies too when energy resolution is kept constant. These results are of some relevance to the choice of Brillouin zones for phonon measurements. (auth)

501 HIGH-RESOLUTION TIME FOCUSING SPECTROMETER FOR QUASI-ELASTIC NEUTRON SCATTERING. Meister, H.; Weckermann, B. (CCR-EURATOM, Ispra, Italy). pp 713-732 of Neutron Inelastic Scattering, 1972. Vienna; International Atomic Energy Agency (1972).

From fifth IAEA symposium on neutron inelastic scattering; Grenoble, France (6 Mar 1972). See STI/PUB-308; CONF-720304-.

A rotating crystal spectrometer with time focusing on to detectors of neutrons scattered elastically in a sample has been constructed at Ispra and installed at the 5-MW heavy-water reactor, Ispra-1. Focusing is achieved by making use of the Doppler effect in neutron reflection with a fast-spinning monochromator crystal. In the time focusing arrangement, the effects on the energy transfer resolution of quasi-elastically scattered neutrons caused by Doppler broadening of the primary neutron velocity and the reflection time, and those caused by the geometrical extension of the crystal, simply cancel each other out. Therefore, since secondary extinction is small, due to the Doppler effect, large crystals can be used with resulting improvement in the intensity. The characteristic features of the spectrometer and the results of performance tests are reported. (auth)

502 MULTI-ANGLE REFLECTING CRYSTAL SPECTROMETER. Kjems, J. K.; Reynolds, P. A. (Danish Atomic Energy Commission, Risoe). pp 733-746 of Neutron Inelastic Scattering, 1972. Vienna; International Atomic Energy Agency (1972).

From fifth IAEA symposium on neutron inelastic scattering; Grenoble, France (6 Mar 1972). See STI/PUB-308; CONF-720304-.

A new crystal spectrometer for inelastic neutron spectroscopy has been developed at the DR 3 reactor at Risø. The main new feature is the analyzer part. It consists of a large analyzer crystal and a position-sensitive detector which allows simultaneous collection of neutrons diffracted by the analyzer within a range of scattering angles, i.e., a range of neutron energies. The performance of the spectrometer is very similar to that of a conventional TOF spectrometer with one movable detector, except for the important difference that the intensity is not attenuated by a chopper. Existing resolution theories for triple-axis spectrometers have been extended for application to the new instrument which turns out to have special advantages for measurements of energy levels in isotropic or nearly isotropic scatterers such as hydrogenous (density of phonon states) and paramagnetic (crystal field excitations) materials. For such measurements the intensity may be enhanced by the use of large mosaic spreads in both the monochromator and analyzer crystals with little or no loss of energy resolution. (auth)

503 CORRELATION TIME-OF-FLIGHT SPECTROMETRY AT PULSED REACTORS. Kroo, N. (Central Research Inst. for Physics, Budapest); Pellionisz, P.; Vizi, I.; Zsigmond, G.; Zhukov, G.; Nagy, G. pp 763-772 of Neutron Inelastic Scattering, 1972. Vienna; International Atomic Energy Agency (1972).

From fifth IAEA symposium on neutron inelastic scattering; Grenoble, France (6 Mar 1972). See STI/PUB-308; CONF-720304-.

It is shown that the correlation technique can be applied at pulsed reactors so that a white ingoing neutron beam can be used and the whole two-dimensional scattering spectrum can be evaluated by data-processing of the correlation type. The principles of the method and a simple error analysis are given. Results of a simple test-run at the IBR-30 pulsed reactor are shown. (auth)

504 STATISTICAL CHOPPER FOR PERIODICALLY PULSED NEUTRON BEAMS. Matthes, W. (CCR-EURATOM, Ispra, Italy). pp 773-785 of Neutron Inelastic Scattering, 1972. Vienna; International Atomic Energy Agency (1972).

From fifth IAEA symposium on neutron inelastic scattering; Grenoble, France (6 Mar 1972). See STI/PUB-308; CONF-720304-.

In time-of-flight experiments using periodically pulsed reactors as a neutron source, the neutron beam falling on the sample shows an inherent periodical structure. The intensity and the spectrum of the input beam at the position of the sample vary periodically in time. A pseudo-statistical modulation of the input beam (just) before the sample will lead to an improvement of the efficiency (resolution, duty cycle) of the experiment. A procedure for obtaining the cross-correlation function between the neutron input beam and the output beam of scattered neutrons is given as well as a description of a method which allows one to evaluate the scattering function of the sample material from the measured cross-correlation functions. The accuracy of the method depends on the detailed time pattern of the incoming intensity. This allows one to characterize each time pattern by a gain factor, giving the improvement in accuracy compared with the conventional time-of-flight experiment. It turns out that, for short input pulses, a local gliding average value of the scattering function taken over a small interval (twice the input pulse length) around the point of measurement is responsible for the accuracy. (auth)

505 INVERSE TIME-OF-FLIGHT METHOD. Hiismaeki, P. (State Inst. for Technical Research, Otaniemi, Finland). pp 803-810 of Neutron Inelastic Scattering, 1972. Vienna; International Atomic Energy Agency (1972).

From fifth IAEA symposium on neutron inelastic scattering; Grenoble, France (6 Mar 1972). See STI/PUB-308; CONF-720304-.

In inverse TOF the state of a chopper (open or closed) is recorded during consecutive time intervals preceding each neutron detected. It is shown that this procedure is equivalent with online correlation or eventually on-line Fourier synthesis depending on the type of chopper used and on the way it is run. The method has been demonstrated with a simple electronic system made up of an ordinary multichannel analyzer and a metal oxide semiconductor (MOS) shift register. The spectrum of a lead monochromator was measured by running at increasing and decreasing speed a Fourier chopper, which obviously leads to the best possible utilization of neutrons both in time and beam area. (auth)

506 HIGH-RESOLUTION MAGNETIC BETA-RAY SPECTROMETER ADAPTED FOR ON-LINE WORK. Johansson, A.; Nyman, B.; Svahn, B.; Bergman, O.; Pettersson, H. (Uppsala Univ.). Nucl. Instrum. Methods; 108: No. 2, 225-235(1973).

A 50 cm radius iron-yoke double focussing beta-ray spectrometer has been equipped to work on-line at the charged particle beam from an EN Tandem accelerator. The principal features of the experimental arrangements, including target and detector systems, beam transport and focussing and the background shielding are described. Experimental results from on-line internal conversion measurements on different isotopes are presented. On the basis of the experience gained in these measurements some of the possibilities of high-resolution on-line electron spectroscopy are discussed. (auth)

507 TECHNIQUES FOR FAST EVALUATION OF Ge(Li)-DETECTOR GAMMA-RAY SPECTRA WITH SMALL COMPUTERS. Nyman, B. (Uppsala Univ.). Nucl. Instrum. Methods; 108: No. 2, 237-241(1973).

A computationally simple technique for evaluating Ge(Li)-detector gamma-ray spectra is described. The energies, intensities and fwhm's of the peaks are determined on the basis of smoothened first and second derivatives, which eliminates the need for a special background subtraction. Results obtained with a computer program employing this technique are presented. (auth)

508 HIGH EFFICIENCY SCINTILLATOR COINCIDENCE SYSTEM FOR ABSOLUTE DETERMINATION OF NEUTRON FLUX DENSITY. Collen, J. (Chalmers Univ. of Tech., Goteborg). Nucl. Instrum. Methods; 108: No. 2, 269-270(1973).

For the accurate determination of neutron flux density by foil activation a high efficiency $\beta-\gamma$ coincidence system has been developed. A special double NE 102A plastic scintillator is used as β-detector and two 3" × 1" NaI(Tl) crystals as γ-detectors. As the detectors surround the foil, the efficiencies are as high as 65% for beta and 24% for gamma peak detection. The accuracy in the determination of the absolute activity of gold foils is 0.5%. Using this detector system an accuracy of 0.6% has been obtained in the absolute determination of thermal neutron flux density and 1.0% in the calibration of a 99.7 mCi Ra–Be neutron source. (auth)

509 GAMMA–GAMMA ANGULAR CORRELATION APPARATUS WITH ON-LINE IRRADIATION SYSTEM FOR THE STUDY OF SHORT-LIVED ISOTOPES. Okano, K.; Kawase, Y.; Hayashi, T. (Kyoto Univ.). Nucl. Instrum. Methods; 108: No. 2, 279-284 (1973).

For the angular correlation measurements on short-lived isotopes produced by (n,γ) reactions, a NaI(Tl)–Ge(Li) angular correlation apparatus connected with on-line irradiation system has been developed. A counting-rate discriminator is used to get sources of the same initial strength and the amount of errors associated with this method is estimated. A multicounter goniometer has also been used in a similar on-line arrangement. Using these systems angular correlation measurements have been made on several short-lived isotopes. Details of the apparatus and some of the results obtained are presented. (auth)

510 INTERPRETATION OF THE RESULTS OF SOME *NEUTRON SPECTRUM ELABORATION PROCEDURES.* Arcipiani, B.; Marseguerra, M. (Comitato Nazionale Energia Nucleare, Bologna). Nucl. Instrum. Methods; 108: No. 2, 301-307 *(1973).*

Certain elaboration procedures of spectrometry data lead to a result which may be interpreted as the convolution of the unknown spectrum with a kernel depending on the instrument and data reduction characteristics. The properties of the kernel allow the *adequacy of the overall technique for spectral determination to* be established. This interpretation has been applied to proton recoil and foil activation methods, having good and poor resolu*tions respectively. (auth)*

511 SIMPLE ALGORITHM FOR BACKGROUND CORREC*TIONS TO γ-γ ANGULAR CORRELATION MEASUREMENTS.* De Raedt, J. (Katholieke Univ., Louvain, Belg.). Nucl. Instrum. Methods; 108: No. 2, 333-334(1973).

A simple algorithm is proposed for the subtraction of background below peaks in angular correlation measurements. (auth)

512 TEMPERATURE COEFFICIENTS OF A NE 213 NEUTRON SPECTROMETER. Weinert, M. (Institut fuer Strahlen*schutz, Stohl, Ger.). Nucl. Instrum. Methods; 108: No. 2, 401-*402(1973).

A NE 213 neutron spectrometer is shown to be useful in the *temperature range from −25°C to + 30°C without special precau*tion. Only the temperature coefficients of the scintillation decay times are to be considered to obtain stable neutron-gamma discrimination. (auth)

513 CONSTRUCTION AND USE OF A THREE Ge(Li) COMPTON POLARIMETER. Butler, P. A.; Carr, P. E.; Gadeken, L. L.; James, A. N.; Nolan, P. J.; Sharpey-Schafer, J. F.; Twin, P. J.; Viggars, D. A. (Univ. of Liverpool). Nucl. Instrum. Methods; 108: No. 3, 497-502(1973).

A three Ge(Li) Compton polarimeter has been constructed, and its sensitivity to γ-ray linear polarization determined in the energy range 0.4 to 4.4 MeV. An example is given describing its application to resolve a spin ambiguity for the 4868 keV level in ^{33}S populated by the reaction $^{30}Si(\alpha,n)^{33}S$ at an α-particle bombarding energy of 9.8 MeV. (auth)

514 COMPTON SPECTROMETER FOR THE ENERGY RANGE BETWEEN 10 AND 300 MeV AND ITS APPLICATION TO PHOTON FLUX AND PHOTON ABSORPTION MEASUREMENTS. Ahrens, J.; Borchert, H.; Zieger, A.; Ziegler, B. (Max-Planck Inst. for Chemistry, Mainz). Nucl. Instrum. Methods; 108: No. 3, 517-523(1973).

A magnetic Compton spectrometer is described which in principle is an extension of an earlier work. The resolution is of the order of 1% over the whole energy range for photon energies between 10 and 300 MeV. Refined techniques and response function calculations by means of the Monte Carlo method allow the application to absolute measurements of photon flux (necessary in photonuclear particle emission cross section measurements) and to precision photon absorption work. (auth)

515 MASS-SELECTING APPARATUS TO MEASURE THE ENERGY LOSS OF FISSION FRAGMENTS IN GASES. Forte, M. (CCR EURATOM, Ispra, Italy); Bertin, A.; Bruno, M.; Vannini, G.; Vitale, A. Nucl. Instrum. Methods; 108: No. 3, 525-532(1973).

An apparatus combining solid-state and gas ionization chamber techniques to measure—for both fragments released in a fission event—the energy lost in a given gaseous range and the residual energy is described. This device allows the measurement of energy loss in gases of fission fragments by selecting their masses. The performances of the apparatus are discussed referring to the data obtained by slowing down fission fragments from ^{252}Cf in gaseous argon. (auth)

516 EFFICIENT, LOW-COST GAMMA-RAY SPECTROMETRY FOR ^{161}Dy (26 keV) MOESSBAUER STUDIES. Forester, D. W.; Ferrando, W. A. (Naval Research Lab., Washington, DC). Nucl. Instrum. Methods; 108: No. 3, 599-601(1973).

Krypton gas-filled proportional counters are shown to provide a superior alternative to other gas-proportional or NaI-scintillation counters and to be competitive with expensive solid-state detectors for ^{161}Dy (26 keV) Moessbauer studies. (auth)

517 FIGURE OF MERIT FOR GAMMA-RAY POLARIMETERS. Logan, B. A. (Univ. of Ottawa); Jones, R. T.; Ljubicic, A. Nucl. Instrum. Methods; 108: No. 3, 603-604(1973).

A figure of merit for gamma-ray polarimeters is proposed. Various polarimeters were analyzed on the basis of the proposed figure of merit. (auth)

518 IMPROVED ZERO-TIME DETECTOR FOR HEAVY ION TIME-OF-FLIGHT SPECTROSCOPY. Dietz, E.; Czarnecki, J. v.; Patscher, W.; Schaefer, W.; Bass, R. (Univ., Frankfurt am Main). *Nucl. Instrum. Methods; 108: No. 3, 607-609(1973).*

Several improvements are described of a recently published timing system for heavy ions, which result in a time resolution of *about 200 ps for ^{14}N and ^{20}Ne ions. (auth)*

519 X AND GAMMA SPECTROMETRY USING SOLID-*STATE DETECTORS. Heath, R. L. (Aerojet Nuclear Co., Idaho* Falls, Idaho). Proc. Jap. Conf. Radioisotop.; No. 10, 160-195 (Apr 1972).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

A brief review is provided on principles and techniques employed in γ and x-ray spectrometry during the past few years. Si(Li) and Ge(Li) solid-state detectors operated at cryogenic *temperatures have been used, which improved detection sensitivity* and energy resolution owing to the development of optoelectronic and pulsed feedback systems for improved noise performance in *preamplifiers, and the development of techniques for the automated* acquisition and analysis of pulse-height spectra. As indicated above, the electronic system developed includes such items as the low-noise preamplifiers utilizing field effect transistors, A-D converters, those for digital stabilization, solution of problems at high counting rates, and tail and peak pile-up rejection. In data analysis, the following points are described: energy measurement, field increment effect, energy calibration, γ intensity measure*ment, peak location, and peak area determination. Application of* small digital computers for the automated real time acquisition and analysis of data including graphical display is shown. (JA)

520 OPERATION OF UNIVERSAL SCINTILLATION COINCIDENCE SPECTROMETER WITH Ge(Li) DETECTORS. Vartanov, N. A.; Samoylov, P. S.; Stugarev, Yu. N. Tr. Soyuznogo Nauch. Issled. Inst. Priborostr.; No. 17, 32-38(1972). (In Russian).

The possibility of operating the Lena series-produced universal spectrometer with Ge(Li) detectors was studied. The operation of this spectrometer with semiconductor detectors was checked in the double and trible fast-slow coincidence modes. The use of a coincidence circuit with long resolving time ($2\tau \sim 200$ ns) allows the time spread in the rise fronts of pulses to overlap with the Ge(Li) detector, achieving 100% effectiveness of coincidence recording. (JPRS)

521 METHOD FOR THE DETERMINATION OF THE TRANSMISSION FUNCTION OF ELECTRON SPECTROMETERS. Poole, R. T.; Leckey, R. C. G.; Liesegang, J.; Jenkin, J. G. (La Trobe Univ., Bundoora, Australia). J. Phys., E. (London); 6: No. 3, 226-228(Mar 1973).

A method is described for the determination of the transmission function of an ultraviolet photoelectron spectrometer of spherical design. Such a function may be determined by this method for any given electron spectrometer; for the spectrometer used in the present work it has the form $T(E'_k, U_p) = 1 + \beta(k_e U_p - E'_k)/E'_k$ where $\beta = 0.97$, k_e is the spectrometer constant (1.007 ± 0.003), U_p is the analyzer pass energy and E'_k is the kinetic energy of photoelectrons emerging from a given gaseous sample. (auth)

High Energy Physics Instrumentation

522 (CERN-Trans-73-1) STUDY OF TRACK FORMATION OF IONIZING PARTICLES IN AN ULTRASONIC FIELD IN A LIQUID HYDROGEN BUBBLE CHAMBER. Akulichev, V. A.; Grebinnik, V. G.; Zhukov, V. A.; Krasil'nikov, V. A.; Manych, A. P.; Selivanov, G. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). Feb 1973. Translation by H. J. Hilke of JINR-P13-6513. 14p. Dep. NTIS (U. S. Sales Only) $3.00.

Results from an experimental investigation on track formation of ionizing particles in a liquid hydrogen bubble chamber are presented. Overheating of the working liquid was performed by joint action of a system of ultrasonic emitters, exciting standing waves with a frequency of 30 kHz, and an ordinary expansion system. For bubbles, which are related to tracks of ionizing particles, the dependence of their size on the ultrasonic pressure amplitude and on the static pressure in the liquid is obtained. When strong ultrasonic fields are excited in liquid hydrogen parasitic boiling (cavitation) is found to appear on the emitter surface, which limits the ultrasonic pressure amplitude and affects the track formation of ionizing particles. The possibilities for the creation of an ultrasonic bubble chamber and its application in high-energy physics are discussed. (auth)

523 (COO-3130-TB-168) SPEX (SPECTROMETER EXECUTIVE): PROGRAMMING MANUAL. Massimo, J. T.; Nelson, B. A.; Levinson, L. J. (Brown Univ., Providence, R. I.). Aug 1972. Contract AT(11-1)-3130. 76p. Dep. NTIS $6.00.

Program information is presented for coding the source modules for the SPEX program. Topics include the normal directives,

the conversion directive, the QTRAN directive, interrupt programming and I/O handlers, preparation of the XSTL, preparation of the XCOM, and the phase communication file PHACOM. (WHK)

524 (FRNC-TH-295) CALCULATION OF THE DEVELOPMENT OF SHOWERS BY THE MONTE-CARLO METHOD AND THE EFFICIENCY OF SPARK CHAMBERS IN THE DETECTION OF γ PHOTONS. Zaccone, H. 1971. 80p. (In French). Dep. NTIS (U. S. Sales Only).
Thesis.

An assembly of large spark chambers (130 × 160 cm) alternating with Pb plates in which photon conversion reactions occur was constructed. The equipment was designed to accurately measure the direction of the photons in the $\pi^- + p \rightarrow n + \gamma$ reaction. In order to calculate the efficiency of the chamber, it was necessary to investigate the development of the shower generated by the photon. In view of accomplishing this, a Monte Carlo program was developed in which photon or electron generated showers are simulated. Previous experimental results (obtained with bubble chambers, Wilson chambers, Cherenkov counters) concerning the development of showers generated in Pb or Cu by electrons having energies between 100 MeV and 1 GeV are presented. The agreement was satisfactory and the program was used to determine the thickness of the Pb plates of a spark chamber intended for the detection of photons having energies between 75 and 350 MeV. (FR)

525 (JINR-P13-6917) UNIVERSAL DECISION MAKING DEVICE FOR ON-LINE DATA SELECTION IN SCATTERING EXPERIMENTS. Guzik, Z.; Basiladze, S. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 9p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.
A universal, digital unit, intended for arithmetic data selection for scattering experiments, using multiple proportional wire chambers, is described. The unit is made using CAMAC standard with fully ECL integrated circuits. The circuit is dc coupled throughout. The maximum time is about 100 ns. (auth)

526 (JPRS-58713) BESM-4 AND SDS-1604A COMPUTER VIDEODISPLAY AND ITS APPLICATION IN PROCESSING SPARK AND BUBBLE-CHAMBER PHOTOGRAPHS. Efimova, A. I.; Zabiyakin, G. I.; Karlov, A. A.; Kretov, A. P.; Kukhtina, I. N.; Levchanovskii, F. V.; Prikhod'ko, V. I.; Trubnikov, V. R.; Sharapova, E. V. Translated from Prib. Tekh. Eksp.; No. 4, 91-96 (1971). 12p. NTIS $3.00.

An examination of the problems of the technical feasibility of a video display based on the cathode-ray tube, light pen and mating of the video display with the computer, and the method of utilization and software of the BESM-4 and SDS-1604A computer video display in application to processing spark and bubble-chamber photographs is given. (auth)

527 (RHEL/M/H-21) MULTIWIRE PROPORTIONAL CHAMBERS. Proceedings of the Meeting at Cosener's House, Abingdon, 3-4 June 1972. Evans, W. M. (ed.) (Rutherford High Energy Lab., Chilton (England)). 1972. 137p. (CONF-720677-). Dep. NTIS (U. S. Sales Only) $9.00.
A separate abstract was prepared for each of the 10 papers presented at the conference. (WHK)

For abstracts of individual papers see: 528–537.

528 (RHEL/M/H-21, pp 7-18) REVIEW OF THE LATEST MULTIWIRE PROPORTIONAL CHAMBER SITUATION AT ORSAY. Massonet, L. 1972.
From meeting on multiwire proportional chambers; Abingdon, England (3 Jun 1972).
Diagrams are given for the new hybrid circuits being developed. The conventional frame-type chambers and large foam-type chambers being developed are described. (WHK)

529 (RHEL/M/H-21, pp 19-35) DEVELOPMENT AND USE OF MULTIWIRE PROPORTIONAL CHAMBERS AT THE RUTHERFORD LABORATORY. Connolly, J. (Rutherford High Energy Lab., Chilton, Eng.). 1972.
From meeting on multiwire proportional chambers; Abingdon, England (3 Jun 1972).
Topics include the first small prototype units, standard small units for use in beam line applications, prototype large unit, low mass unit, and delay line readout. (WHK)

530 (RHEL/M/H-21, pp 36-51) MULTIWIRE PROPORTIONAL CHAMBER DEVELOPMENT AT UNIVERSITY COLLEGE, LONDON. Davies, J. K.; Fisher, S. M.; Imrie, D. C.; Lush, G. J. (University Coll., London). 1972.
From meeting on multiwire proportional chambers; Abingdon, England (3 Jun 1972).
The small multiwire proportional chamber system being developed for use in studying hadron states produced coherently by the interaction of high-energy protons with helium nuclei at the CERN PS is described. Chamber construction, electronics, and construction are discussed. (WHK)

531 (RHEL/M/H-21, pp 52-63) COMPARISON OF 3 READ-OUT SYSTEMS FOR PROPORTIONAL CHAMBERS AT CERN. Pizer, I. (CERN, Geneva). 1972.
From meeting on multiwire proportional chambers; Abingdon, England (3 Jun 1972).
The three systems of readout used at CERN for multiwire proportional chambers are described: (1) The CERN-Heidelberg System (Exp S93 at P.S.) which has 5400 wires and uses flat cable as delay element. It has minimum electronics on the chambers and a high trigger and event rate. It has operated 1½ years. (2) The "Split-Field-Magnet" Project. In preparation with 50,000 wires, all electronics up to memory flip-flop and readout gate will be on the chamber. The readout logic is 70 meters distant from the chamber. (3) Modular readout system for smaller experiments. Pre-amp on chamber with twisted wire transmission. It has modules for 16 wires—22 modules = 352 wires per crate. (auth)

532 (RHEL/M/H-21, pp 64-70) MULTIWIRE PROPORTIONAL CHAMBER TRIGGER LOGIC. Milborrow, R. (Rutherford High Energy Lab., Chilton, Eng.). 1972.
From meeting on multiwire proportional chambers; Abingdon, England (3 Jun 1972).
One of the current activities of the Rutherford HEP Electronics Group is the construction of the electronics for a straight path detector for the Omega Project at CERN. The detector consists of three parallel MWPC's situated along the axis of the incident particle trajectory, with the two outside chambers equidistant from the center chamber, a target being situated between the middle and last chambers. The function of the instrument is to detect non-interacting particles which result in straight trajectories, and provide a veto for the trigger logic on their occurrence. Each chamber has an effective length of 32 wires, as seen by the detector. Some solutions to the problem are discussed, and current ideas on MWPC trigger logic are reviewed. (auth)

533 (RHEL/M/H-21, pp 71-79) EXPERIENCE WITH LARGE MWPC's FOR THE CERN SPLIT FIELD MAGNET SYSTEM. Sauli, F. (CERN, Geneva). 1972.
From meeting on multiwire proportional chambers; Abingdon, England (3 Jun 1972).
The multiwire proportional chamber system for the Split Field Magnet for detecting colliding beam events in the CERN ISR is briefly described. (WHK)

534 (RHEL/M/H-21, pp 80-93) USE OF MULTIWIRE PROPORTIONAL COUNTERS FOR PARTICLE IDENTIFICATION. Allison, W. W. M. (Nuclear Physics Lab., Oxford). 1972.
From meeting on multiwire proportional chambers; Abingdon, England (3 Jun 1972).
The possibility of operating a multiwire proportional chamber in a truly proportional mode and measuring the dE/dx ionization energy loss in combination with the transition radiation for high-energy particle identification is discussed. A preliminary experiment and results are discussed, and plans for future experiments are indicated. (WHK)

535 (RHEL/M/H-21, pp 94-114) SYSTEM OF LARGE DRIFTCHAMBERS. Walenta, A. H. (Univ., Heidelberg). 1972.
From meeting on multiwire proportional chambers; Abingdon, England (3 Jun 1972).
The construction, operation, readout, and location accuracy of multiwire drift proportional chambers are discussed, and the principal properties of drift chambers are compared with those of spark chambers, proportional wire chambers, and scintillator hodoscopes. (WHK)

536 (RHEL/M/H-21, pp 115-126) TWO DIMENSIONAL READ-OUT OF DRIFTCHAMBERS. Walenta, A. H. (Univ., Heidelberg). 1972.
From meeting on multiwire proportional chambers; Abingdon, England (3 Jun 1972).
The readout of the anode wires in proportional wire chambers and multiwire driftchambers only permits the determination of one coordinate of the particle position, i.e., the coordinate X perpendicular to the wires in the plane of the chamber. The second coordinate Y can be obtained by the readout of the induced signals on the cathode wires. The principle is shown and discussed. (WHK)

537 (RHEL/M/H-21, pp 127-135) PARTICLE LOCALIZATION WITH VERY HIGH ACCURACY. Charpak, G. (CERN, Geneva). 1972.
From meeting on multiwire proportional chambers; Abingdon, England (3 Jun 1972).
Two methods for measuring the position of particles in high-energy secondary beams with accuracies of the order of 10 μm

are discussed. These methods include the use of a succession of drift chambers and the use of multiwire proportional chambers. (WHK)

538 TRACK LENGTH FLUCTUATIONS IN ELECTRON-PHOTON SHOWERS OF ENERGY 20 TO 200 MeV. Nurenberg, J. A. St. Louis; Washington Univ. (1972). 276p. University Microfilms Order No. 73-5054.

Thesis (Ph.D.).

This work is concerned with gamma ray or electron detectors constructed of plates of heavy metal of sufficient total thickness to degrade nearly all of the energy of the incident particle to unobservable components. Electron track segments may be observed between these plates by several means—for example, spark chambers, cloud chambers, bubble chambers, and scintillation counters. For uniform plate thicknesses the total track length is proportional to the number of electron track segments counted between the plates. This count depends on the incident energy of the particle and its angle of incidence on the detector. For this reason the count is useful in gamma ray or electron energy estimation. It is subject to fluctuations caused both by the radiation of unobserved intermediate energy photons (1 to 10 MeV in lead) and by the splitting of the total track length by high energy photon radiation. The latter effect produces a number of track pairs the ends of which have low probability for leaving observable effects. The general problem of gamma detection in multiplate chambers is described. Arguments are set forth to show that most of the energy information is contained in the track segment count, and several simple models for count fluctuations are discussed. In the second chapter a model for the distribution of track segment count is developed from the physical processes contributing to shower development. The bremsstrahlung cross-section, whose dependence on electron energy is a complicating feature, is approximated by a constant "effective" cross-section. The validity of this approximation is discussed from the perspective of a less severe approximation and, finally, is referred to experimental data for verification and evaluation of the effective cross-section. A second parameter, the probability for observing a track segment from an intermediate energy photon is also evaluated from experimental data. The data came from gamma rays in the energy range 20 to 220 MeV produced by the decay of the π^o mesons from the process $K^+ \rightarrow \pi^+\pi^0$. These gamma rays were observed in a spark chamber with eight 0.5 radiation length lead plates (4 r.l. total) followed by eleven 0.22 r.l. plates of copper. The track segment count in the copper section is normalized to a lead section with 0.5 r.l. plates. Data from the work of Kajikawa (J. Phys. Soc. Japan 18, 1365, (1963)) are also compared with the model. The model gives agreement with the data when the effective cross-section and the intermediate photon spark production probability are estimated by least squares fitting to the data distributions. The values of the parameters so obtained fall within the limits imposed by the known values of the bremsstrahlung cross-section and by the electron track lengths that can be generated by intermediate energy photons. (Diss. Abstr. Int., B)

539 DEVELOPMENT OF LARGE AREA Si(Li) DETECTOR FOR COSMIC RAY ISOTOPE OBSERVATION. Nakagawa, S.; Tsukuda, M.; Okudaira, K.; Hirashima, Y.; Yoshimori, M. (Rikkyo Univ., Tokyo). pp 214-217 of Large Balloon Symposium, 1971. Tokyo; Tokyo Univ. (1972). (In Japanese).

From large balloon symposium; Tokyo, Japan (13 Mar 1972).

High-accuracy measurement of isotope ratios by means of a $dE/dX \cdot E$ telescope composed of a large area Si(Li) detector was planned, because the observation of isotopes gives an important key for studying the source of cosmic rays, propagation mechanisms in astronomical space, the cosmic ray modulation mechanism due to the sun, and the life of the cosmic ray. As the first step, a large area Si(Li) detector was developed and tested. Mass of isotopes has not been determined with sufficient accuracy with the detectors available. The $dE/dX \cdot E$ detector planned has an area of 20 cm^2 and a thickness of 1 mm, and the E detector has an area of 20 cm^2 and a thickness of 3 mm. A plastic scintillator is used as the anti-coincidence detector. Using this telescope with the semiconductor detector, separation of ^{12}C and ^{13}C with the accuracy of $M \leq 0.5$ seems to be possible up to the extent of 100 MeV/nucl. (JA)

540 DEVELOPMENT OF PROPORTIONAL COUNTER FOR HIGH ENERGY PRIMARY COSMIC RAY MEASUREMENT. Kuge, A. (Rikkyo Univ., Tokyo). pp 210-213 of Large Balloon Symposium, 1971. Tokyo; Tokyo Univ. (1972). (In Japanese).

From large balloon symposium; Tokyo, Japan (13 Mar 1972).

The development of a measuring instrument of higher energy resolution has been continued since 1969 for energy spectra measurement of high-energy primary cosmic rays above 10 GeV. The instrument is a telescope mainly composed of multistage large-area proportional counters. Sea level μ-mesons were employed in the simulating experiment because stress was put on observing the Landau fluctuation and increase based on the theory of relativity in the energy loss of high-energy charged particles in gases. X-rays of 3 and 5.9 keV from ^{55}Fe and of 31 keV from ^{133}Ba were used to calibrate the absolute value of the energy loss. There seems to be bias between the energy loss distribution of the μ beam measured in the geometry of the proportional counter sandwiched by two scintillators and that distribution predicted by Landau distribution. The purity of filling gas and shape of effective volume may be the dominant cause of the bias. It is expected that fabrication of the counter will be initiated in 1972 after many pretests. (JA)

541 ACCELERATOR EVALUATION OF A SPARK-CHAMBER EXPERIMENT FOR GAMMA-RAY ASTRONOMY. Bignami, G. F.; Paul, J.; Pfeffermann, E.; Swanenburg, B. N.; Scheepmaker, A.; Voges, W. H.; Wills, R. D. Nucl. Instrum. Methods; 108: No. 2, 257-268(1973).

The ESRO satellite COS-B will carry a single experiment, aiming at the detection and energy measurement of cosmic gamma radiation at energies above 25 MeV. The instrument incorporates a wire matrix spark chamber and a caesium-iodide energy spectrometer. The response of the instrument to gamma rays has been determined using a tagged gamma-ray beam (25 to 300 MeV). A first estimate of the susceptibility to charged-particle background has been obtained from an exposure of the instrument to protons of 1450 MeV/c. The measured performance characteristics of the experiment are presented and discussed. As a result of the tests improvements in the design of the flight instrument, leading to increased sensitivity to gamma rays and a lower susceptibility to background, could be incorporated. (auth)

542 FLASH TUBE HODOSCOPES FOR PARTICLE DENSITY MEASUREMENTS. Samorski, M. (Univ., Kiel). Nucl. Instrum. Methods; 108: No. 2, 285-289(1973).

Details on the construction and the performance characteristics of a 31 m^2 neon hodoscope are presented. The detector has been in operation at Kiel since 1965, investigating the density distribution of charged particles in the cores of extensive air showers. It is shown that a device of this type meets most of the requirements for a large area detector in cosmic ray work. (auth)

543 PERFORMANCE OF A GAS-CHERENKOV GAMMA-RAY TELESCOPE. Koch, D. (Cornell Univ., Ithaca, NY); Ball, S. E. Jr.; Campbell, M.; Delvaille, J. P.; Greisen, K.; McBreen, B.; Fazio, G. G.; Hearn, D. R.; Helmken, H. F. Nucl. Instrum. Methods; 108: No. 2, 349-353(1973).

The first balloon flight of a novel telescope for high-energy gamma rays provided a short period of operation at altitude which served mainly to confirm the correct functioning of the instrument, including its orientation control. In 13 min exposure to the Crab Nebula, upper limits were determined (with 95% confidence) of 6×10^{-6} cm^{-2} s^{-1} for the pulsed flux and 13×10^{-6} cm^{-2} s^{-1} for the total flux of gamma rays above 220 MeV. An upper limit of 1.2×10^{-4} cm^{-2} s^{-1} rad^{-1} was found for the gamma rays above 120 MeV from the galactic disk near the anticenter. The atmospheric background above 120 MeV was measured as 1.1×10^{-3} per g s sr, in agreement with a number of earlier determinations. (auth)

544 FAST DIGITAL PROCESSOR FOR APPLICATIONS IN HIGH ENERGY PHYSICAL EXPERIMENTS. Derevshchikov, A. A.; Guzik, Z.; Matulenko, Yu. A.; Nurushev, S. B.; Smirnov, E. V.; Solovyanov, V. L. (Inst. for High-Energy Physics, Serpukhov, USSR). Nucl. Instrum. Methods; 108: No. 2, 381-383(1973).

A digital processor constructed to investigate small angle elastic scattering of negative pions by protons is described. The results of tests of this device at the 40 GeV/c particle beam are presented. The rejection coefficient of the direct beam experimentally determined was found to be 200 ± 25 for the cut-off angle region up to 0.8 mrad. The use of this device allowed to increase the rate of the data collection by a factor of 16. (auth)

545 HIGH-ACCURACY DRIFT CHAMBERS AND THEIR USE IN STRONG MAGNETIC FIELDS. Charpak, G. (CERN, Geneva); Sauli, F.; Duinker, W. Nucl. Instrum. Methods; 108: No. 3, 413-426(1973).

A method is proposed that allows the construction of drift multiwire proportional chambers with adjustable electric field suitable for the detection of high-energy charged particles in strong magnetic fields. Typical measured accuracies go from 50 to 200 μm, varying with the drift length, at 16 kG. The simple mechanical construction allows the wire distance to be adapted to the expected counting rate, even in the same chamber. Furthermore, the advantages of a current division method to obtain both orthogonal coordinates from the same wire are discussed. (auth)

546 GLASS TRACK CHAMBER. Breskin, A.; Charpak, G. (CERN, Geneva). Nucl. Instrum. Methods; 108: No. 3, 427-429 (1973).

A hodoscope of glass tubes filled with neon + helium has been constructed using tubes of a diameter of the order of 1 mm. Good operation is observed with electric fields nearly parallel to the tubes. A simple detector with high spatial resolution can thus be constructed. (auth)

547 ELECTRON CALIBRATION OF A HIGH-ENERGY COSMIC RAY DETECTOR. Crannell, C. J. (Federal City Coll., Washington, DC); Gearhart, R. A.; Hagen, F. A.; Jones, W. V.; Kurz, R. J.; Ormes, J. F.; Price, R. D.; Silverberg, R. F.; Simnett, G. M. Nucl. Instrum. Methods; 108: No. 3, 445-459(1973).

The response of the GSFC High Energy Cosmic Ray Detector has been studied using electrons in the energy range 5.4 to 18 GeV. A semi-empirical analytic form has been developed to determine the starting points and the energies of electron-induced cascade showers. The energy resolution thus obtained has a fwhm of 17%, and the starting point can be determined to within 0.1 to 0.2 radiation length. The results of this response calibration provide a basis on which cosmic ray electrons can be reliably identified and analyzed in the presence of a large proton background. (auth)

548 DEVICE TO IDENTIFY MUONS AT HIGH ENERGIES. Bourquin, M. H.; Saxon, D. H. (Columbia Univ., Irvington, NY). Nucl. Instrum. Methods; 108: No. 3, 461-465(1973).

Muons may be distinguished from hadrons by their lack of strong interactions in a hadron-shower calorimeter. Pulse-height spectra are shown for various arrangements of up to four shower sampling probes at momenta of 13.9 and 20.1 GeV/c. Implications for the performance at higher energies are discussed. (auth)

549 RADIOFREQUENCY SPARK CHAMBER. Sayag, G. J. (Paris Univ., Orsay, France). Nucl. Instrum. Methods; 108: No. 3, 477-484(1973). (In French).

A spark chamber was excited by an undamped radiofrequency pulse of about 1 μs duration, between 5 and 15 MHz. These experiments, carried out with α-particle tracks, led to the determination of the threshold electric fields: 2.8 and 3 kV/cm (peak values) respectively for visual and photographic detection at maximum sensitivity. The tracks revealed under the best conditions were about 1 mm wide. From these experimental results were calculated the parameters relative to the behavior of the electrons in commercial neogal during the pulse: mean kinetic energy (11.0 eV), electron multiplication factor ($\approx 10^3$) and partial ambipolar diffusion coefficient (≈ 500 cm^2 s^{-1}). The value of the sensitive time, estimated to be less than 200 ns, at the threshold of detection, is discussed. The observed resolution time (or clearing time) is 1.8 μs. The new fast-triggering high-tension generator of undamped wave-trains used for these experiments will be described in a separate publication. (auth)

550 CAMAC MODULE TO HELP EVENT RECOGNITION IN HIGH ENERGY PHYSICS. Bourgeois, F.; Corre, A. (CERN, Geneva). Nucl. Instrum. Methods; 108: No. 3, 485-492(1973).

A time-to-digital converter is described, and its use in identifying events with multiple beam tracks is presented as well as results obtained on the Omega spectrometer at CERN. (auth)

551 HIGH-RESOLUTION TOTAL ABSORPTION SPECTROMETER FOR SIMULTANEOUS DETECTION OF SEVERAL HIGH-ENERGY γ-RAYS. Holder, M. (Technische Hochschule, Aachen); Radermacher, E.; Staude, A.; Darriulat, P.; Deutsch, J.; Pilcher, J.; Rubbia, C.; Tittel, K.; Grosso Pilcher, C.; Scire, M.; Villari, A. Nucl. Instrum. Methods; 108: No. 3, 541-550(1973).

A large γ-ray total absorption spectrometer originally developed to observe the decay $K_L \rightarrow 2\pi^0$ by detecting all of its four γ-rays is described. It consists of 61 blocks of lead-glass, each one observed by separate photomultipliers. Thin lead converters and wire spark chambers in front of the hodoscope determine the direction of the γ-rays. (auth)

552 APPLICATION OF THE ALICE FLYING SPOT DIGITIZING SYSTEM TO OSCILLOSCOPE AND SPARK CHAMBER DATA. Hodges, D. (Argonne National Lab., IL); Lindquist, J.; Nelson, B.; Swallow, E. C.; Schwartz, D. M. Nucl. Instrum. Methods; 108: No. 3, 551-556(1973).

The ALICE flying spot digitizing system has been used successfully to process oscilloscope data from an experiment on the beta decay of the Λ hyperon and optical spark chamber data from a measurement of the cross-section for the reaction $\pi^- p \rightarrow \Lambda K$. Several problems encountered in these applications are discussed along with the procedures developed for dealing with them. (auth)

553 DETECTION OF 10- TO 100-MeV PHOTONS WITH LEAD-GLASS CHERENKOV COUNTERS. Sober, D. I.; Arman, M.; Blasberg, D. J.; Haddock, R. P.; Leung, K. C.; Nefkens, B. M. K. (Univ. of California, Los Angeles). Nucl. Instrum. Methods; 108: No. 3, 573-579(1973).

The use of a 10 × 10 × 15 cm^3 lead-glass Cherenkov counter as a detector of photons with energies as low as 10 MeV is described. A procedure for calibrating the efficiency of the counter without the use of tagged photons is presented. Using electron-beam measurements and a Monte Carlo calculation, it was found that a normally-incident photon is detected with an efficiency of 62% at 15 MeV and 87% at 25 MeV. (auth)

Radiometric Instruments

Refer also to abstracts 47 and 1514.

554 (AD-749967) DEVELOPMENT OF A ZERO-G GAUGING SYSTEM. Final Report, 1 November 1970-9 June 1972. Bupp, F. E. (TRW Systems Group, Redondo Beach, Calif.). Aug 1972. Contract F04611-71-C-0010. 133p. (AFRPL-TR-72-86). NTIS.

The ultimate objective of this project was the development of a zero-g gauging system based on the absorption of gamma radiation. The numerous subsystem parameters of a nucleonic gauge were interrelated in closed form and subjected to appropriate tradeoff analyses and optimization routines to synthesize gauging systems capable of meeting the prescribed performance parameters. Particular emphasis was placed on achieving high levels of accuracy (1 percent or better over the entire range of full- to empty-tank conditions) with gauges configured completely external to spherical tanks fueled with cryogenic propellants. (auth)

555 (SC-DR-720744) AREAL DENSITY MEASUREMENTS OF LOADED THIN FILMS. Kenna, B. T.; Nelson, G. C. (Sandia Labs., Albuquerque, N. Mex.). Oct 1972. 24p. Dep. NTIS $3.25.

Various techniques, utilizing the absorption of radiation in materials, are described for measuring the areal density of thin Er films on Mo substrates. The radiation used can be either from an external radioactive or x-ray source, or internally produced, as in the case of tritiated films, by the interaction of beta radiation with matter. The three outstanding advantages of these techniques are nondestructiveness, direct measurement of the areal density without assumption of film densities or measurement of film thicknesses, and the speed with which the analyses can be accomplished. (auth)

556 (UCID-16242) NUCLEAR DETECTION OF BURIED LAND MINES. Waggoner, J. A. (California Univ., Livermore. Lawrence Livermore Lab.). 1967. Contract W-7405-Eng-48. 7p. Dep. NTIS $3.00.

Nuclear techniques for the detection of buried land mines are briefly discussed. The use of neutron inelastic scattering and neutron capture for detecting the nitrogen in TNT, C-3, and C-4 explosives is considered. (WHK)

557 OPTIMUM MEASUREMENT OF THE THICKNESS OF AN OBJECT BY A REFLECTED RADIATION METHOD. Troitskii, I. N. Defektoskopiya; No. 1, 27-35(1973). (In Russian).

The possible accuracy of a thickness gage based on reflected radiation was evaluated from the statistical character of scattered radiation. The maximum probability was estimated and its accuracy was compared with the accuracy of other contemporary reflection thickness gages. (tr-auth)

558 PULSED NEUTRON WELL LOGGING APPARATUS FOR DETERMINING BACKGROUND RADIATION. Youmans, A. H. (to Dresser Industries, Inc.). U. S. Patent 3,706,884. 19 Dec 1972. Filed date 30 Jun 1967. 12p.

A system is described for radioactivity well logging comprising a source of neutrons and radiation detection means in a spaced relationship to said source. The detection system includes at least a first and second gate, means for causing said source to produce a discrete burst of neutrons and for triggering said gates to provide an indication functionally representative of the rate of decline of at least a portion of said neutrons in a medium, also, means for combining the outputs of said gates to provide a signal directly proportional to the neutron counting rate at time zero following said neutron burst and means for recording said indication of the neutron counting rate as a function of depth within the well are provided. (WHK)

559 STUDY OF THE RELATIONSHIP BETWEEN ALBEDO FAST NEUTRONS AND DENSITY (EXCHANGE OF EXPERIENCE). Voropaev, Yu. A.; Pozdneev, D. B.; Ryabinin, V. B. (Gorky State Univ., USSR). Ind. Lab. (USSR) (Engl. Transl.); 38: No. 5, 715-716(May 1972).

Translated from Zavod Lab.; 38: No. 5, 566-567(May 1972).

Density measurement of materials based on albedo fast neutrons was studied. Po-Be and Po-B neutron sources and a stilbene scintillation detector were used. The relationship between the apparatus numerical albedo fast neutrons and the density of the diffuser made from B_4C was studied and compared with results using albedo gamma rays. (WHK)

560 MEASUREMENT OF CARBON FILM THICKNESS ON METALS WITH THE ELECTRON-PROBE MICROANALYSER. Sawatzky, A.; Jones, S. (Atomic Energy of Canada Ltd., Pinawa, Manitoba). Can. Res. Develop.; 5: No. 6, 23-36(Nov 1972).

The possibility of using an electron-probe microanalyser as a means of nondestructively measuring the thickness of fouling films (mainly carbon) which form on heat-transfer surfaces in organically cooled nuclear reactors was studied. Calibration curves were obtained by vapour-depositing weighed amounts of carbon on various substrates, and then measuring the intensity of characteristic x rays produced on bombarding the coated and uncoated surfaces with monoenergetic electrons at accelerating potentials of 20 to 50 kV. The thickness of carbon coatings on Al, Zr, and Fe, was measured in the range 0.1 to 1.5 mg/cm^2 with an accuracy of 10%. The x-ray excitation distribution for carbon was also determined. This quantity is defined as the distribution in depth of the emission of characteristic x rays due to electron bombardment of a specimen's surface. (CA)

561 RADIATION BACKSCATTERING APPARATUS USING AN APERTURED PRECIOUS STONE AS AN OBJECT SUPPORT. Fischer, H. U. S. Patent 3,714,436. 30 Jan 1973. Priority date 20 Mar 1970, Federal Republic of Germany (F. R. Germany). 6p.

An apertured ring made of a metal having a lower atomic number for use in instruments for measuring the thickness of layers by means of backscattered radiation is described. It has on its upper side a bearing surface for the object to be measured, a small recess in relation to the height of said ring for the unhindered passage of radiation, said recess leading into the bearing surface, and a recess in the form of a circular cone which extends from the lower side of the apertured ring and leads into the first small recess in the vicinity of its upper end. The small recess is provided in a jewel for fine mechanics which has a low atomic number and is held adhesively in a bore on the upper side of the ring. (Official Gazette)

562 NEW POLISH CONVEYOR SCALES. Scharf, W. (Politechnika, Warsaw). Pomiary, Automat., Kontr.; 18: 295-298(1972). (In Polish).

Two scales using radioisotopes are described; one for apron conveyors, and the other for belt conveyors of small load intensity, below 10 kg/m. The problem of calibrating isotope scales is also discussed and a calibrating means for checking the indication reproducibility is described. (auth)

Radiation Effects on Instrument Components, Instruments, or Electronic Systems

563 COMBINED MEASURING PROCESS DEVICE FOR CARRYING OUT THIS PROCESS AND NUCLEAR REACTOR FITTED WITH SUCH DEVICES. Baudelet, C.; Gilly, L. (to ACEC). Belgian Patent 752,430. 23 Jun 1970.

A process is described for the measurement of the speed of breakdown of an electrically conducting material, and/or of irregularities in this material affecting the induced currents in the conducting material, characterized by the fact that there is arranged along the path of the conducting material an induction coil that is supplied with an alternating current with which one detects or measures the intensity and/or fluctuations of the currents induced in the conducting material, and that the measured quantities are analyzed by appropriate means. (BE)

564 RADIATION RESISTANCE OF PLASTIC MATERIAL FOR CABLE. 1. Application to Low Noise Coaxial Cable for Nuclear Measuring Instruments. Ishikawa, H.; Ishibashi, M.; Mogi, A. (Fujikura Cable Works, Ltd., Tokyo). Fujikura Densen Giho; No. 45, 75-83(Jan 1972). (In Japanese).

An investigation of the effects of gamma radiation on the mechanical properties of several kinds of polymers was undertaken to improve the resistance of communication equipment to irradiation. Most polymers were damaged in air at room temperature by total irradiation of 10^8 rads from ^{60}Co. Improved resistance of insulation and jacket for control cable to irradiation using radioprotection agents was attempted. Consequently, good results were produced on the radiation stability. A further test is now in progress to insure the radiation stability at higher gamma doses. (auth)

565 CURRENT TRANSFER THROUGH DIELECTRIC IN IRRADIATED MIS-STRUCTURES. Girli, V. A.; Kondrachuk, A. V.; Shakhovtsov, V. I. (Inst. of Physiology, Kiev). Solid State Commun.; 12: No. 4, 249-252(15 Feb 1973).

The current-voltage and current-temperature characteristics of MIS-structures under the different electric fields in the dielectric ($10^4 + 5 \times 10^6$ V.cm^{-1}) within the temperature interval 77 to 470°K were investigated before and after γ-irradiation. The mechanisms of the current transfer are considered within the limits of accepted models. There are some discrepancies between the present data and known mechanisms of current transfer in such structures. The possible reasons for these discrepancies are analysed. The effects of γ-irradiation on the I-V and I-T-characteristics are discussed on the bases of information about the nature of different components responsible for the current formation. (auth)

566 EFFECT OF γ RADIATION ON Si–SiO$_2$–Mo/Au SYSTEM. Kassabov, Ya. D.; Kaschieva, S. B.; Sto'ev, I. G. (Inst. of Physics, Sofia). Compt. Rend. Acad. Bulg. Sci.; 25: No. 11, 1491-1493(1972).

p-channel MOS transistors with Mo–Au double metallization were irradiated by ^{60}Co γ rays. Measurements were made by the channel conductivity method before and after irradiation and were analyzed to find the energy distribution of the levels in the forbidden gap of Si. The hole mobility and the density of the fast states and the oxide charge are plotted. It was found that irradiation increases the threshold voltage and decreases the charge carrier mobility in the channel, as a result of an increase in oxide charge and the appearance of a new defect center on the interface at 0.20 eV above the valence band. (DLC)

Miscellaneous Instruments

Refer also to abstracts 607, 949, 1127, and 1648.

567 (AERE-R-6664) IMPLEMENTING CAMAC-COMPUTER SYSTEMS. Hooton, I. N.; Lewis, A.; Whitehead, N. P. (Atomic Energy Research Establishment, Harwell (England)). Dec 1970. 7p. Dep. NTIS (U. S. Sales Only) $3.00. UK 1s. 2d.

CAMAC hardware provides the interaction with the external world required for real-time computer systems. The concept of a "coupler" (comprising device handler software and a hardware controller) is examined together with an instruction set which defines the performance of the coupler but is independent of the combination of hardware and software used in its implementation. (auth)

568 (CEA-R-4425) SUSCEPTIBILITY OF PULSE NUCLEAR MEASURING EQUIPMENT TO ELECTRICAL INTERFERENCES. Buisson, J. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Feb 1973. 34p. (In French). Dep. NTIS (U. S. Sales Only) $3.75.

The parts of neutronic measuring equipment most likely to be adversely affected by electrical interferences are those involving pulse operation. An analysis of the interference mechanism is presented. It is demonstrated that electrical interferences of any origin (electrical interferences due to variations in the supply current, electrical interferences due to energy radiated from electrical components, or difference in effective ground potentials) result in the same phenomenon, i.e., the circulation of a current in the shielding of the equipment. This current represents the unique cause of interference effects to the measurements made. The mechanism through which this current interacts with the connectors and the shielding of the electronics and cables is studied. The concept of transfer impedance (a characteristic of the immunity of the cables to electrical interferences) is defined; the results obtained with different cables are presented, particular attention being given to a mu-metal cable recently developed by the C.E.A. (auth)

569 (FRNC-TH-346) CONSTRUCTION AND CALIBRATION OF AN EXPERIMENTAL DEVICE FOR MEASURING THE ENERGY LOSS EXPERIENCES BY IONS COLLIDING WITH RARE GAS ATOMS. Angles, J. M. (Toulouse Univ. (France)). 1972. 95p. (In French). Dep. NTIS (U. S. Sales Only) $6.75. Thesis.

Equipment was developed for analyzing the energy and angular distribution of an ion beam (atomic or molecular) having an energy ranging from 5 to 10 keV scattered by a noble gas target. Experiments were conducted with an He$^+$–He system. Studies were also effected on the dissociation of H_2^+ ions by the bombardment of a He target. These studies were performed as preliminary tests to ensure the correct operation of the energy analysis equipment. A summary is given of the future uses envisaged for the equipment. (FR)

570 (JINR-P13-6945) PULSE GENERATOR 0.1 Hz TO 300 MHz. Zvada, M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 16p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

A pulse generator intended for generation of logic signals in the frequency range of 0.1 Hz to 300 MHz is described. The pulse width at the 50% amplitude level is equal to 1.6 ns, the risetime does not exceed 0.8 ns, and the falltime is not worse than 1 ns. In the frequency range of 0.1 Hz to 80 MHz the pulses of any width above 6 ns are possible to be obtained. Transistor switches provide the pulse amplitude of 18 mA. The generator was designed at the Experimental Nuclear Physics Department (Laboratory of Nuclear Problems). (auth)

571 (JINR-P13-6974) DEPENDENCE OF THE LINEAR RANGE OF THE AMPLITUDE CASCADE UPON THE TIME CHARACTERISTICS OF THE TREATED SIGNAL. Semenov, B. Yu. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 7p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The effect of time (frequency) characteristics of signals upon the linear range of the amplifying cascade has been considered. It has been shown that the logarithmic amplitude-frequency characteristic of the amplifying cascade having a broken feedback in a certain scale shows the limit of the linear cascade range. (auth)

572 (KFK-1234) CAMAC TIMER MODULE TYPE LEM-52/2.6 SPECIFICATION AND DESCRIPTION. Borcherding, K.; Gruber, P.; Ottes, J.; Tradowsky, K. (Kernforschungszentrum, Karlsruhe (West Germany). Labor fuer Elektronik und Messtechnik). Jan 1973. 39p. (In German). Dep. NTIS (U. S. Sales Only) $4.00.

The Type LEM-52/2.6 CAMAC Timer Module is the central unit of control of the CAMAC Scaler-Timer System's mode of operation. Parts of this Scaler-Timer System are: 50-MHz scalers (in a special application used as interval time scaler), binary-to-BCD converters with decimal display, timing signal drivers (in additional crates used as slave timers), and the appending software. The module contains a 24-bit gate time register, a clock pulse generator at 1 MHz and 100 kHz frequency respectively with an output jacket at the front panel, and the complete time control of the system. Each mode of operation not initiated by a dataway instruction can not work without admittance by the control register. One dataway instruction each enables or disables the whole system. The timing phase inverts from gate time to interval time and back in synchronization with the clock pulse at control signals from external devices (start/stop ext.), from connected modules (at completion of preset interval time mode and preset count mode), from the gate time register (preset gate time mode) or from the dataway (start/stop gate time). The end of a cycle can be announced by an external signal or by a dataway information to the control register. The upper limit of the preset values for gate time given by the frequencies of the internal clock pulse generator (2.8 min) may be exceeded by use of frequencies from external generators fed into the input "CLOCK" (with TTL-level). A status register holds all important informations on the timer's state of operation including the LAM sources (overflow of gate time register, end of preset count mode, external control signals). This status register permits reading all over the time but postulates reading in each case of the module's LAM (Look-at-Me). A lamp indicates gate time phase. (auth)

573 (KFK-1655) CAMAC MODULE TYPE LEM-52/9.4 FOR CONTROLLING AN ADC PULSE (12 BIT, 50 MHz). Heep, W.; Klein, H. W. (Kernforschungszentrum, Karlsruhe (West Germany). Labor fuer Elektronik und Messtechnik). Jan 1973. 14p. (In German). Dep. NTIS (U. S. Sales Only) $3.00.

A CAMAC module controlling the Series 2200 Analog-to-Digital Converter (ADC) produced by Nuclear Data Inc. is described. The ADC is designed for the USAEC NIM system and therefore needs a control unit for use in CAMAC crates, which connects the ADC to the CAMAC Dataway. (auth)

574 (KURRI-TR-89, pp 157-159) PERFORMANCE OF THE CONVERGING BEAM CHOPPER. Yamada, S. (Kyoto Univ.). 1971. (In Japanese).

In proceedings of the 3rd study meeting on neutron measurements.

A new type of chopper is proposed, for which converging of the beam is available. The chopper consists of several rotors arranged on a same axle. The rotational speed of each rotor is different with one another by the use of gears set among them. Calculations show that the intensity of the neutron beam can be increased with this chopper more than ten times compared with that of the conventional one for the same resolution. (auth)

575 (LBL-1522) CAMAC SPECIFICATIONS. Kirsten, F. A. (California Univ., Berkeley. Lawrence Berkeley Lab.). Dec 1972. Contract W-7405-eng-48. 11p. (CONF-721202-17). Dep. NTIS $3.00.

From nuclear science symposium; Miami Beach, Florida, USA (6 Dec 1972).

The experience with CAMAC installations resulting from its widespread use has inevitably led to suggestions for changes in the specifications. The NIM and ESONE Dataway Working Groups spent nearly a year discussing these suggestions during the recently completed process of rewriting and revising the CAMAC specifications. Some of the suggestions were included in the revised specification after careful evaluation of any compatibility problems that might arise. Others were felt to lie outside the intended scope of the specification. The scope and intent of the CAMAC specification are briefly discussed. Then the significant additions and changes to the Dataway specifications are listed, along with some background information. Reference is also made to the information contained in the document TID-25877 "Supplementary Information on CAMAC System." (auth)

576 (RD/B/N-2531) CAMAC AT BERKELEY NUCLEAR LABORATORIES. Walker, W. N. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Dec 1972. 20p. Dep. NTIS (U. S. Sales Only) $3.00.

A description is given of the installation of three minicomputer installations interfaced to their associated input/output equipment using CAMAC. The applications are a computer based data collection system for a reactor physics stack, a gamma scanning rig, and an ultrasonic attenuation rig. Details are given of some of the advantages and disadvantages which have resulted from the use of CAMAC. (UK)

577 LIMB HOLDER POSITIONER FOR BONE MINERAL ANALYZER. Burkhalter, R.; Congdon, G. L. (to Norland Corp.). U. S. Patent 3,715,587. 6 Feb 1973. Filed date 26 Oct 1970. 6p.

The disclosure relates to instruments for performing in vivo analysis of bone mineral content by measuring the absorption of a scanning beam of monoenergetic photons. Novel means are used for supporting and positioning a limb so that a predetermined increment of a bone therein can be scanned under repeatable conditions. Scanning is done with a tissue equivalent material surrounding the corresponding portion of the limb so that radiation transmission is substantially uniform through the tissue regions of the scan but has a sharp discontinuity where bone is in the beam. (Official Gazette)

578 IRREVERSIBLE BEHAVIOUR OF AN ELECTROCHEMICAL DEVICE FOR THE MONITORING OF CARBON IN LIQUID SODIUM. Aksaranan, C. (Chulalongkorn Univ., Bangkok); Morris, D. R. J. Appl. Electrochem.; 2: No. 4, 309-313 (Nov 1972).

The use of a fused salt solution of calcium carbide as the electrolyte in an electrochemical cell for the monitoring of carbon in metal solutions is shown to be unsatisfactory due to partial electronic conductivity in the electrolyte. The experimental results of Salzano et al. (Nuclear Technology; 10:325 (1971)) using such a device with liquid sodium–carbon solutions are shown to correspond to a steady state situation in which a carbon flux, equivalent to the electron flux in the electrolyte, is established from the graphite electrode to the steel barrier separating the electrolyte from the liquid sodium. The cell e.m.f., calculated by assuming this carbon flux to be equal to the carbon flux by diffusion through the steel barrier to the liquid sodium, agrees within the uncertainty limits of the calculation, to the measured e.m.f. (auth)

579 IMPROVEMENTS IN OR RELATING TO MASS SPECTROMETERS. Merren, T. O. (to Associated Electrical Industries Ltd.). British Patent 1,302,045. 4 Jan 1973. Filed date 19 Feb 1970. 6p.

Reference is made to mass spectrometers that include a magnetic analyzer and to improved means for accurately moving the heavy magnet of such instruments. In the instrument described, the means for controlling the pivotal movement of the magnet comprises a rotatable cam or eccentric that acts on the magnet either directly or through a linkage of variable length. The linkage may comprise a rope or chain secured to a winch. (UK)

580 CRYSTALS WITH A GRADIENT IN THE LATTICE PARAMETER AS NEUTRON MONOCHROMATORS. Rustichelli, F. (Institut Max von Laue-Paul Langevin, Grenoble, France). pp 697-711 of Neutron Inelastic Scattering, 1972. Vienna; International Atomic Energy Agency (1972).

From fifth IAEA symposium on neutron inelastic scattering; Grenoble, France (6 Mar 1972). See STI/PUB-308; CONF-720304-.

In general the selection of a monochromatic neutron beam of wavelength band $\Delta\lambda$ is effected by using a single crystal having an angular disorientation $\Delta\theta$ in the reflecting planes, this $\Delta\theta$ being obtained through a mosaic spread or a curvature. A new type of neutron monochromator is presented that selects a wavelength band $\Delta\lambda$ due to a variation Δd in the lattice spacing, instead of a variation in the inclination of the reflecting planes. The gradient of the lattice parameter is obtained by growing a crystalline solid

solution with a gradient in concentration. The results presented here refer to a Cu–Ge monochromator, obtained with the Czochralski technique in which a modification was introduced in order to be able to change continuously the concentration of the bath during the growing process. The monochromators with a gradient in the lattice parameter present several advantages as compared with the conventional ones; in particular they effect the monochromatization of a well-collimated neutron beam, without introducing an angular dispersion. As a consequence, they can find an interesting application in the composite monochromator systems, where no limitation exists, in this case, in the width (i.e., in the intensity) of the monochromatic band diffracted in a fixed secondary direction. Another main characteristic of this type of monochromator is that its energy resolution does not depend on the energy of the beam selected. The criteria (based on the dynamical theory of diffraction) used to calculate the optimum values of the gradient of d for different reflections are discussed. Data obtained in the experimental investigation with γ-ray and neutron diffraction of the Cu–Ge crystals are given and compared with that of a conventional Cu monochromator with mosaic spread. (auth)

581 THEORY OF MULTIVARIABLE STATISTICAL CHOPPERS UTILIZING UNCORRELATED PSEUDORANDOM SEQUENCES. Amadori, R.; Hossfeld, F. (Kernforschungsanlage, Juelich, Ger.). pp 747-761 of Neutron Inelastic Scattering, 1972. Vienna; International Atomic Energy Agency (1972).

From fifth IAEA symposium on neutron inelastic scattering; Grenoble, France (6 Mar 1972). See STI/PUB-308; CONF-720304-.

The theory of the correlation time-of-flight method using a single statistical chopper is briefly summarized on the basis of a generalized theory. It is shown that uncorrelated pseudorandom sequences are well suited for extensions of the correlation technique to multivariable methods which make effective use of the polychromatic primary neutron beam. In these multivariable arrangements the time-of-flight spectra of all available or of some preselected primary energies can be determined simultaneously. The theory of multivariable techniques is presented following the lines of the generalized theory of the single-chopper correlation method. Two basically different concepts are discussed: (1) a series of monochromator crystals which are adjusted in line behind each other focusing neutrons of definite primary energies on to the sample. The polychromatic primary beam is modulated by one chopper wheel in front or by magnetic chopping of the crystals according to uncorrelated pseudorandom binary sequences. In this multivariable setup, the duty cycles of the pseudorandom sequences can be adjusted independently for the different primary energies, thus optimizing the gain factor which has been derived as a function of the various experimental parameters. (2) The statistical double chopper method with two chopper wheels. If the periods of the two associated pseudorandom binary sequences are chosen coprime, no phase-shifting of the chopper wheels is necessary, and, owing to an important fourth-order-correlation property of pseudorandom binary sequences, the time-of-flight spectra for different primary energies can be separated by two-dimensional cross-correlation. Explicit gain factors of the multivariable techniques compared with equivalent conventional and sequential single-chopper correlation experiments are calculated. Finally, the extension of the correlation theory to neutron time-of-flight experiments at pulsed reactors is presented utilizing the properties of coprime periods of the pulsed reactor and the neutron choppers involved. (auth)

582 STATISTICAL CHOPPER FOR TIME-OF-FLIGHT SPECTRUM FILTERING. Pellionisz, P.; Kroo, N.; Mezei, F. (Central Research Inst. for Physics, Budapest). pp 787-795 of Neutron Inelastic Scattering, 1972. Vienna; International Atomic Energy Agency (1972).

From fifth IAEA symposium on neutron inelastic scattering; Grenoble, France (6 Mar 1972). See STI/PUB-308; CONF-720304-.

In neutron scattering experiments based on the correlation-type time-of-flight method, the statistical accuracy is influenced by the form of the spectrum. If high intensity peaks are filtered out, the statistical accuracy of the smaller peaks is increased. It is shown that adequate spectrum-filtering can be achieved by introducing a further pseudo-statistical modulation of the ingoing intensity and by a corresponding on-off control of the detected intensity. The principles of this new filtering technique are described and compared with crystal filtering and other types of separation methods. Statistical efficiency and realization problems are discussed. A short report is given of an experimental check in which a chopper of the spin-flipping type driven by two superimposed pseudo-random sequences was used for simultaneous correlation and filtering. The results are compared with those obtained by the simple correlation method. (auth)

583 PSEUDORANDOM MODULATION IN POLARIZED NEUTRON DIFFRACTOMETRY. Mezei, F.; Pellionisz, P. (Central Research Inst. for Physics, Budapest). pp 797-802 of Neutron Inelastic Scattering, 1972. Vienna; International Atomic Energy Agency (1972).

From fifth IAEA symposium on neutron inelastic scattering; Grenoble, France (6 Mar 1972). See STI/PUB-308; CONF-720304-.

Two versions of an experimental method for polarized neutron diffraction studies with a pseudostatistically controlled spin-flipper device are described which permit neutrons to be separated with respect to energy and the different contributions to be determined. (auth)

584 IMPROVEMENTS IN OR RELATING TO THE MEASUREMENT OF SURFACE POTENTIALS. Crossland, W. A.; Davey, A. B. (to Standard Telephones and Cables Ltd.). British Patent 1,300,524. 20 Dec 1972. Filed Date 25 Feb 1971. 5p.

An improved method is described for comparing the surface potential of an electrically conductive surface with that of an electrically conductive reference surface, spaced therefrom. The making of such comparisons finds particular application in testing the integrity of thin plated layers. The method consists of positioning a source of ionizing radiation so that it ionizes the gas between the two surfaces and monitoring the resulting potential difference between the surfaces. The reference surface may be Au, and the source of ionizing radiation may be ^{241}Am. The arrangement constitutes an electrolytic cell, whose internal resistance is significantly lowered by the ionized gas. (UK)

585 BONE MINERAL ANALYZER. Rose, F. A. (to Norland Corp.). U. S. Patent 3,715,588. 6 Feb 1973. Filed Date 26 Oct 1970. 40p.

A bone mineral analyzer includes a radioactive photon source and a NaI(Tl) scintillation detector secured to a holder movable along a transverse scanning line. A tissue-covered bone is held in a tissue equivalent cover to produce a constant thickness profile with a photon scanning beam selectively absorbed by the bone and the tissue and tissue equivalent covers. A dual speed motor moves the holder at a rapid search speed to locate the bone and hold the beam in fixed relation to the tissue and tissue equivalent cover for establishing and storing a tissue reference signal. A slow scan speed is established for scanning the bone and establishing a bone-tissue signal. Corresponding logarithmic signals are subtracted and integrated over the width of the bone to produce a bone mineral related output which drives digital meters. A selection switch interconnects a logic circuitry to permit selection between a pair of bones spaced in a common tissue. Timing circuits improve the characteristic response of the system. Calibration for the digital reader is connected to the output side of the integrator to permit calibration adjustment without disturbing the signal in the integrator. (Official Gazette)

586 IMPROVEMENTS IN OR RELATING TO MASS SPECTROMETRY. (to Associated Electrical Industries Ltd.). British Patent 1,299,800. 13 Dec 1972. Filed Date 13 Jul 1970. 2p.

Mass spectrometry apparatus is described for measuring the magnetic induction in the magnetic analyzer of a mass spectrometer. It comprises a movable coil, mounted in relation to the spectrometer, so that, in use, the magnetic induction in the analyzer interacts with current in the coil, means being provided to give an indication of the extent of such interaction, this being a measure of the magnetic induction. The coil may carry a mirror, to function as a mirror galvanometer. The coil movement may be damped hydraulically, and a non-linear graduated scale may be provided on the indicating means so that indications are directly proportional to the specific mass of ions instantaneously reaching the mass spectrometer ion collector. (UK)

587 ELECTROMAGNETIC RADIATION IMAGE DISPLAYING PANEL. Ohoshima, N.; Himeno, K.; Tani, N. (to Matsushita Electric Industrial Co. Ltd.). U. S. Patent 3,715,589. 6 Feb 1973. Filed Date 2 Oct 1970. 10p.

An image converting panel for displaying a pattern of short wave-length electromagnetic radiations, such as x-rays onto the image converting panel, is described. The panel has a transparent substrate having at least the following layers thereon in the order from the bottom up; an electroluminescent layer having a dielectric constant of 7 to 40 and a thickness of d_1; a reflective layer having a dielectric constant of 10 to 200 and a thickness of d_2; an opaque layer having a specific resistivity of 10^5 to 10^{10} Ω-cm and a thickness of d_3; a photoconductive layer having a linear relation of dark current to ac electric field up to a least 800 V/mm and a thickness of d_4; an electromagnetic radiation permeable electrode; and a covering layer having a high resistance to humidity. The dimension d_2 is equal to 0.1 to 0.3 d_1; d_3 is equal to 0.1 to 0.3 d_1; and d_4 is equal to 3 to 10 d_1. (Official Gazette)

588 CRYOMAGNETIC EQUIPMENT FOR NEUTRON DIFFRACTION STUDIES. Girard, B.; Hellegouarc'h, J. Tech. CEM (Co. Elec. Mec.); No. 84, 16-19(May 1972). (In French).

Cryomagnetic equipment producing a 5 T field in an enclosure whose temperature can be varied between 1.5 and 300°K is presented. The field is produced by a superconducting coil. The equipment was developed for neutron scattering experiments. (FR)

589 SIMPLE TIME-TO-AMPLITUDE CONVERTER AND A QUADRUPOLE COINCIDENCE UNIT BASED ON INTEGRATED-CIRCUITS FOR POSITRON ANNIHILATION STUDIES. Wang, J. B. (New England Inst. for Medical Research, Ridgefield, CT); Chuang, S. Y.; Tao, S. J.; Ogata, A. Nucl. Instrum. Methods; 108: No. 2, 253-255(1973).

A square pulse generator constructed from a fast integrated-circuit MC 1661L and a fast discriminator constructed from a tunnel diode form the basic building blocks of the delayed coincidence unit for the time-to-amplitude converter. The integrated-circuit MC 1661L is also used for the quadrupole coincidence unit. The delayed coincidence unit is used to measure the mean lives of positron annihilation. The quadrupole coincidence unit is used to measure the angular correlation of the two-gamma annihilation of the positron–electron pair. The specific features of the circuits are simple, fast, stable and moderate in cost. (auth)

590 USE OF p-i-n DIODES IN NUCLEAR ELECTRONIC CIRCUITS. Horvath, P.; Mukhin, S. V.; Richvickij, S. J.; Streit, V.; Zvada, M. (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Instrum. Methods; 108: No. 2, 357-363(1973).

Attenuators and a bipolar pulse shaper using the p-i-n diodes are described and short specifications are presented. Small-signal characteristics of the diode-twins were measured in the 30 to 900 MHz frequency range. The diode characteristics and some advantages of the p-i-n diode use in pulse circuits for nanosecond and sub-nanosecond range are discussed. (auth)

591 TIMING CIRCUITS WITH COSMOS COMPONENTS. I. May, F.; Marschik, W. (Institut fuer Elektronik, Vienna). Nucl. Instrum. Methods; 108: No. 2, 375-376(1973). (In German).

The high input resistance of COSMOS integrated circuits is an attribute which can be utilized particularly to realize numerous different timing circuits. A versatile multivibrator is described. The frequency of this multivibrator can be varied over more than 6 to 7 decades and the duty cycle is adjustable up to 10,000 : 1. The rise and fall times of the output pulses are independent of frequency and duty cycle. (auth)

592 TIMING CIRCUITS WITH COSMOS COMPONENTS. II. May, F.; Marschik, W. (Institut fuer Elektronik, Vienna). Nucl. Instrum. Methods; 108: No. 2, 377-379(1973). (In German).

The high input resistance of COSMOS integrated circuits is an attribute which can be utilized particularly to realize numerous different timing circuits. Several circuits are described which are able to protect digital input circuits against electrical disturbances. Advantages and disadvantages of the different protection circuits are discussed. (auth)

593 SAMPLE CHANGER FOR AUTOMATIC IRRADIATION APPARATUS. Okano, K.; Kawase, Y. (Kyoto Univ., Osaka). Nucl. Instrum. Methods; 108: No. 3, 503-507(1973).

A sample changer for automatic irradiation apparatus with on-line measurement system has been constructed and used for the study of a short-lived activity accompanied with a longer-lived one. Constructional details and some of the results obtained using this apparatus are presented. (auth)

594 SIMPLE TECHNIQUE FOR CRYSTAL ALIGNMENT IN CHANNELLING EXPERIMENTS. Price, P. B. (Univ. of New South Wales, Kensington, Australia); Hollis, M. J.; Newton, C. S. Nucl. Instrum. Methods; 108: No. 3, 605-606(1973).

A crystal alignment technique utilizing laser light reflection is described. The technique is applicable to crystals having cleaved or optically polished faces of known orientation and should be particularly useful in some channelling experiments. (auth)

595 MEASURING ATMOSPHERIC PRESSURE BY USING RADIOACTIVE EMITTERS. Kozlov, O. V.; Polenov, B. V.; Khazanov, B. I. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.; No. 17, 106-115(1972). (In Russian).

Various methods of measuring pressure in the range from 40 to 760 mm Hg by using radioactive emitters with respect to mean free path and specific losses of energy of alpha particles, and with respect to scatter of beta particles are considered. The technical specifications are given as well as possible fields of application of methods of this type. (JPRS)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

Refer also to abstract 1959.

Isotope Separation (Industrial)

Refer also to abstract 321.

596 CENTRIFUGE WITH SELF-MAINTAINED GAS BEARINGS. Giovansily, D.; Le Manach, J. (to Commissariat a l'Energie Atomique). French Patent 2,123,694. 15 Sep 1972. Filed Date 28 Jan 1971. 15p. (In French).

A centrifuge device for the separation of ^{235}U and ^{238}U from UF_6 is presented. A bowl which rotates about its axis on gas bearings situated at its ends is contained in a leak-tight enclosure. The bowl is provided with at least one thrust bearing. The gas bearings are fed with gas obtained from the periphery of the bowl. The device is also provided with at least one compressor positioned inside the bowl at one of its ends. The compressor discharges into a chamber defined by the outer surface of the bowl and the leak-tight enclosure. This chamber possesses at least one of the bearings fed with gas from the compressor outlet. At each end of the bowl and in the wall of the enclosure, a maze type structure followed by molecular pump system operates to reduce the pressure in this region. (FR)

597 NUCLEAR FUELS FROM M.A.N. CENTRIFUGES. Laussermair, F. M.A.N. (Maschinenfabrik Augsburg Nuerenberg) Forschen, Planen, Bauen; No. 3, 34-40(1972). (In German).

The generation of clean and economic energy seems to be possible in the future by means of light-water reactors. The enrichment of the needed quantities of uranium fuel can be achieved by separation nozzle, gaseous diffusion, or centrifugal method (with uranium hexafluoride). The economic centrifugal method which is briefly described is preferable for Europe. (GF)

598 ISOTOPIC SEPARATION OF ^{15}N. 1. Effect of Feed Flow, Column Height, and Temperature for the System $NO-HNO_3$. Koehret, B.; Guernier, G.; Enjalbert, M. (Institut de Genie Chimique, Toulouse). Chem. Eng. Sci.; 28: No. 3, 735-739(Mar 1973). (In French).

The effects of hydrodynamic parameters, feed flow, packing, and height of column on the enrichment in ^{15}N in nitric acid for the system HNO_3-NO were studied. An empirical law permitting the determination of the number of theoretical plates as a function of the flow and of the height of packing is proposed for operation with total reduction reflux gases. The systematic study of the influence of the temperature indicates the existence of an optimum isotherm (45°C). The utilization of a discontinuous temperature profile leads to an enrichment that is lower than that at isothermic operation. (auth)

599 ISOTOPIC SEPARATION OF ^{15}N. 2. Mathematical Model for the Operation with Draw-Off of a Separation Column for the System $NO-HNO_3$. Guernier, G.; Nielsen, J.; Enjalbert, M. (Institut de Genie Chimique, Toulouse). Chem. Eng. Sci.; 28: No. 3, 741-749(Mar 1973). (In French).

A mathematical model of the operation with draw-off of a ^{15}N separating column was developed. The model makes it possible to predict the transitory and steady states of a column operating with draw-off by simply knowing the total reflux level and the nitrogen hold-up of the column. Good agreement was found between the results of the model and experiments with draw-off. The model shows that for a given column a feed flow exists for each concentration of the desired product which leads to a maximum production. (auth)

600 GAS CENTRIFUGE PLANTS FOR THE ENRICHMENT OF URANIUM-235. Groth, W. (Univ., Bonn). Naturwissenschaften; 60: No. 2, 57-64(1973). (In German).

After a short historical introduction, the independent work on gas centrifuge development in the German Federal Republic, the United Kingdom, and the Netherlands is discussed as far as classification allows. The Treaties of Collaboration and the Tripartite Organizations for the production of centrifuge and plants and for the operation of the plants are described. An account is then given of plants in operation and under construction and of those planned up to 1980. Finally, the author compares the economics under European conditions of the gas centrifuge method and other enrichment processes, and estimates the future market for separation work. (GF)

601 WILL THE CENTRIFUGE ACHIEVE A BREAKTHROUGH IN URANIUM ENRICHMENT? Braatz, U. (Uran Isotopentrennungs GmbH, Juelich, Ger.). Atomwirt., Atomtech.; 18: No. 3, 114-116(1973). (In German).

The actual questions regarding the fuel cycle are concerned with the prospects of the various competing uranium enrichment techniques in terms of the future erection of enrichment plants in Europe. The advocates of the centrifuge technique were very optimistic about its prospects under the conditions of future European demands and markets. The separation nozzle process still lags in respect of its development status but offers an interesting development potential. The advocate of the diffusion process, which has been discussed exclusively in terms of the French technology, could quote the operating experience in the field which is already available. It cannot be excluded that two or even three processes could exist in parallel if the present predictions of the separation capacity required in the eighties are confirmed. (GF)

602 SUPPORTING DEVICE PRINCIPALLY INTENDED FOR A CENTRIFUGE. Barriac, J.; Pfeiffer, H.; Thomsen, H.; Bourgain, L. (to Commissariat a l'Energie Atomique). French Patent 2,120,401. 18 Aug 1972. Filed date 31 Dec 1970. 9p. (In French).

A supporting device for a part rotating at high speed about a vertical axis is presented. This part may be in the form of a cylindrical centrifuge bowl used for the isotopic separation of U isotopes from UF_6. It consists of a circularly symmetric male part and a corresponding female part, one of these parts being attached to the rotating part and the other being fixed. One of the parts is provided with a spiral groove. A very thin film of viscous liquid separates these parts. This liquid has a low saturation vapor pressure and a viscosity which drops sharply with increasing temperature. (FR)

Isotopic Power Sources

603 (DP-1325) SAVANNAH RIVER LABORATORY ^{60}Co POWER AND HEAT SOURCES. Quarterly Progress Report, October-December 1972. Angerman, C. L. (comp.). (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Feb 1973. Contract AT(07-2)-1. 17p. Dep. NTIS $3.00.

The purpose of the Savannah River Laboratory program on ^{60}Co is to provide data that will be required for designing, fabricating, and operating ^{60}Co heat sources. Primary emphasis is on selecting materials for encapsulating Co fuel forms and establishing temperature limits for operation of capsules in normal and accident conditions. Progress is reported on corrosion of candidate capsule materials in marine environments; brittleness of arc-cast iridium stock used to encapsulate Co compounds; long-term performance testing of superalloy capsules at 850 to 1000°C and of noble metal capsules at 1600°C with the capsules containing unirradiated Co metal; oxidation testing of Hastelloy X capsules; and performance testing of ^{60}Co-fueled thermoelectric generator. (LCL)

604 (WASH-1220) ISOTOPES DEVELOPMENT PROGRAMS RESEARCH AND DEVELOPMENT: 1972. Progress Reports on Sponsored Work. (Division of Applied Technology (AEC), Washington, DC). Feb 1973. 133p. Dep. GPO $2.10.

The objectives, results obtained during 1972, and future plans for each research and development project within the USAEC Isotope Development Program are summarized. The following major technical program areas are discussed: radioisotope production and materials; thermal applications; radiation systems development; process radiation; and radiation preservation of foods. (LCL)

605 MARKET ANALYSIS ON THE APPLICABILITY OF A RADIONUCLIDE BATTERY WITH DYNAMIC ENERGY CONVERTER. Kipp, P. R. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt mbH, Geesthacht, Ger.). Erdoel-Erdgas Z.; 88: No. 4, 139-147(1972). (In German).

For the energy supply of systems and missions in marine technology, it is necessary to develop modern energy sources. Based on this requirement, four variants of a nuclear energy supply system with different converter units are presented, i.e., Stirling hot-gas engine, hot-gas rotary piston engine, steam turbine with organic working medium in closed circuit, and gas turbine in closed circuit. A market analysis was performed in order to determine the required quantities of such a system and to investigate the special requirements of the users. The results of the inquiry are summarized and analyzed in several graphs. (GF)

606 APPLICATION AND PROPERTIES OF THE TRANSURANIUM ELEMENTS. Keller, C. Ind. At. Spatiales; 16: No. 6, 12-39(Dec 1972).

The use of transuranic elements in space technology and medicine is discussed. In addition to Pu, which is used in fast breeder

reactors, the principal transuranic elements used are ^{238}Pu, ^{244}Cm, employed as energy sources (thermoelectric converters) and ^{252}Cf, employed as a radiation source. The quantities of these elements used vary between a few μg of ^{252}Cf (medical applications) and several kg ^{238}Pu (isotopic batteries). The experimental methods used to investigate transuranic elements are very dependent on the quantities available. Experiments with elements lying between Bk and Es are conducted using sub-micromethods. Data available for Nobelium, Lawrencium, and elements 104 and 105 were obtained with quantities ranging from traces to single atoms. Autoradiation effects strongly affect the preparation and the stability of such compounds. Certain physico-nuclear characteristics are only observed in the actinide region. This applies, particularly, to fission phenomena: spontaneous fission, fission isomers, and delayed fission. ^{257}Fm is the lightest nucleus to undergo a symmetric fission with thermal neutrons. (FR)

Radiation Sources

Refer also to abstracts 46, 604, and 606.

607 (COO-1422-117) EFFECTS OF THE POLYENERGETIC CHARACTER OF THE SPECTRUM OF ^{125}I ON THE MEASUREMENT OF BONE MINERAL CONTENT. Sandrik, J. M.; Judy, P. F. (Wisconsin Univ., Madison. Dept. of Radiology). 1971. 13p. Dep. NTIS.

The spectrum of the radionuclide ^{125}I, which is extensively used for measurements of bone mineral content (BMC), consists of five photon energies ranging from 27.2 to 35.4 keV. The effect on the measurement of BMC due to the preferential attenuation of the low energy components of this spectrum in the bone mineral (hydroxyapatite) and soft tissue has been investigated. A theoretical examination of this effect was made by calculating the exponential attenuation of each component of the spectrum individually and then summing the attenuation factors weighted by the fractional contribution to the spectrum of each component. The results of similar calculations for aluminum in water were found to be in good agreement with measurements indicating the validity of the above method for predicting hardening effects. The measurements and calculations were also performed with different thicknesses of tin filtration in the beam. Values of BMC determined by the above method and by a linear estimator were found to agree to ±1% over the range 0.6 to 1.5 g/cm² of hydroxyapatite. Variations in soft-tissue cover changed the value of BMC by 0.5% to 1.0% per cm of unit density material. The largest effect was due to variations of tin filtration which can change the value of BMC by 0.12% to 0.16% per μm of tin. These calculations indicate that the variation between tin filters used in measurements of BMC should be limited to ±2.5 μm. (auth)

608 (DP-1322) NEUTRON SPECTRA FROM CALIFORNIUM-252 WIRE SOURCES. Herold, T. R. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Mar 1973. Contract AT(07-2)-1. 18p. Dep. NTIS $3.00.

Neutron spectra from four types of ^{252}Cf wire sources were measured with commercially available ^{3}He and ^{6}Li "sandwich" spectrometers. The sources all emitted essentially pure fission neutron spectra. The presence of nonradioactive cationic impurities at concentrations up to the accepted limit of four times the californium content produced insignificant amounts of additional neutrons. Spectra from the four source types were obtained between 0.5 and 4.7 MeV with the ^{3}He spectrometer and between 0.2 and 5.0 MeV with the ^{6}Li spectrometer with no detectable variation from the fission spectrum obtained from an electroplated source containing high-purity ^{252}Cf. The neutron spectrum from a wire source containing samarium and terbium did not differ significantly from the ^{252}Cf fission spectrum between 0.5 and 8.6 MeV as measured with the ^{3}He spectrometer. The instrumentation and techniques for fissile neutron detection and counting are described. Spectrometer response to neutrons of different energies was verified by resolving the energy groups from a plutonium–beryllium neutron source. (auth)

Design and Fabrication

609 (KURRI-TR-89, pp 150-156) NEUTRON SOURCE OF PLANE TYPE AND ITS APPLICATIONS. Kanda, K. (Kyoto Univ.). 1971. (In Japanese).

In proceedings of the 3rd study meeting on neutron measurements.

The advantages of a plane type neutron source are discussed from the viewpoints of the space resolution and neutron intensity, of which type is applicable to the cases of (γ,n) and (γ,f) reactions. A new plane type Sb–Be source was produced, which consists of a beryllium disk (0.5 cm in thickness and 25 cm in diameter) and six antimony bars separately irradiated. By use of the Sb–Be source, the neutron age in water was measured. Using a fission plate and another plane type neutron source, the neutron ages in water and polyethylene were measured in combination with the KUR heavy water facility. Moreover, the average neutron cross sections of some threshold reactions for fission neutrons were measured. (auth)

610 TECHNIQUES OF PREPARATION OF ^{32}P BETA-APPLICATOR AND ASSOCIATED RADIATION SAFETY DEVICES FOR STUDIES OF RADIATION BURNS IN ANIMALS. Jain, M. P.; Zutshi, D. N.; Nagpal, K. K.; Nayak, N. A. (Inst. of Nuclear Medicine and Allied Sciences, Delhi). Indian J. Med. Res.; 60: No. 8, 1181-1185(Aug 1972).

Design and fabrication of a ^{32}P beta-applicator and associated radiation safety devices for producing radiation burns in animals are described. As compared with the usually used ^{90}Sr, ^{32}P was chosen in spite of its short half-life of 14 days, because of its (1) emission of energetic beta rays: maximum energy 1.7 MeV corresponding to a range in tissue of 7.9 mm, (2) less radiotoxicity than that of ^{90}Sr and hence less radiation hazards in handling, and (3) ready availability in India. The material used to fabricate the applicator is perspex which has a low atomic number and hence reduces to a minimum the bremsstrahlung radiation produced from the energetic ^{32}P beta rays. The applicator delivers uniformly a surface dose of 30,000 rads/h over a circular area of radius 1 cm. While not in use, it is kept in a specially designed perspex container. Beta shielding made of perspex is used while handling the applicator. Remote control tongs about 20 cm in length and perspex eye shields 1 cm thick are designed and fabricated for safety during handling the applicator. (INIS)

Industrial Uses

Refer also to abstracts 639, 641, 658, 659, 663, 664, and 668.

611 (BNL-50348) CONCRETE-POLYMER MATERIALS FOR HIGHWAY APPLICATIONS. Progress Report No. 2. Kukacka, L. E.; Romano, A. J.; Reich, M.; Auskern, A.; Colombo, P.; Klamut, C. J.; Pike, R. G.; Steinberg, M. (Brookhaven National Lab., Upton, N. Y.). Apr 1972. 171p. Dep. NTIS $3.00.

The work to date has indicated that great improvements in the structural and durability properties of highway-quality concrete can be obtained by monomer impregnation and in situ polymerization by either radiation or thermal-catalytic means. Samples of conventional weight and structural-light-weight concretes containing several types of aggregates and with various water/cement ratios were prepared by the Federal Highway Administration (FHWA) and impregnated at Brookhaven National Laboratory. After impregnation with methyl methacrylate and radiation polymerization, all the materials produced high-strength (>15,000 psi) composites. Comparable strengths were also obtained with thermal-catalytically polymerized specimens. The data indicate that concretes prepared from locally available materials can be used in the production of polymer-impregnated concrete. In conjunction with this effort, encapsulation methods were evaluated following the vacuum-soak impregnation operation to determine the effectiveness in minimizing monomer drainage and evaporation losses. The choice of encapsulation method appears to depend upon the initial density of the concrete. Polymerization under water yields results that are at least comparable with those obtained by using forms when high-density (>140 lb/ft³) materials containing limestone, quartzite gravel, or diorite are impregnated. Forms are more effective for lower density materials such as Solite or slag, probably because their use reduces the drainage losses to which low-density materials are more susceptible to negligible values. However, the differences in strength are not large (<15%). (auth)

612 (CEA-CONF-2210) RADIOACTIVE TRACER APPLICATION IN THE CHEMICAL ENGINEERING FIELDS. Margrita, R. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Jun 1972. 18p. (In French). (CONF-721062-3). Dep. NTIS (U. S. Sales Only) $3.00.

From NUCLEX 1972: 3rd international fair of nuclear industries and technical meetings; Basel, Switzerland (16 Oct 1972).

The use of radioactive tracers in the area of chemical engineering makes possible a better understanding of the flow of fluids in industrial reactors. A primary class of applications called "classic" that has as its object the determination of the essential characteristics of circuits is now a routine procedure in France. In this connection the measurements of flow, volume, and the loss by leakage in a heat exchanger can be cited, and measurements of interfaces can be made. The development of tracer methods and the possibilities of the signal offered by computers have permitted the exploitation, to the greatest degree, of the information given by radioactive tracers. The impulse response or distribution of

residence time of the phases, obtained by labeling with a radioactive tracer, is a source of information making possible multiple investigations. This information can be utilized in a simple manner to define, for example, some anomalies of functioning—residual volume, short circuits; permits, by adjustment of a mathematical model, the identification of the method of flow of material and the determination of the characteristic flow parameters; and can be used for problems of regulation (substances in suspension or in solution) or even in relation to chemical reaction kinetics. Some examples illustrate these different types of applications. (tr-auth)

613 (ZAED-Bibl-5-12) IRRADIATION OF FOOD. Gruenewald, T.; Strahlmann, B. (Bundesforschungsanstalt Fuer Lebensmittelfrischhaltung, Karlsruhe (West Germany)). Nov 1972. 56p. (In German). Dep. NTIS (U. S. Sales Only) $5.00.

A bibliography of 274 references on various aspects of food irradiation is presented. Topics included are irradiation technology, wholesomeness, applications at low and high doses, radapperitization, radicidation, improvement of products, chemical and physical properties, and microbiology. An author index and English language subject index are included. (HLW)

614 DEVICE FOR SEEDS AND OTHER OBJECTS IRRADIATED WITH FAST NEUTRONS OF REACTOR IRT-1000. Troshev, T.; Damyanov, D.; Georgiev, R. Izv. Fiz. Inst. Aneb, Bulg. Akad. Nauk.; 22: 195-200(1972). (In Russian).

An irradiation apparatus was mounted in proximity to the active zone of the IRT-1000 Reactor in Sofia. An experiment for measuring thermal and fast neutron flux and measuring doses from gamma rays and fast neutrons was carried out. The thermal neutron flux was 1.5×10^9 n/cm^2 s when measured by the irradiation of gold plates and the fast neutron flux was 5.1×10^8 n/cm^2 s when measured by activation of sulfuric tablets. The doses for seeds from gamma rays and fast neutrons produced from graphite and polyethylene were measured with an ionizing camera of the Gray-type. It was found that in the container of the irradiation device D_n = 22.2 rad/s and D_γ = 3.1 rad/s and $D_n/(D_n + D_\gamma) = 0.885$. The data were measured with reactor power at 1000 kW. (auth)

615 EXPERIMENTAL DETERMINATION OF THE PARAMETERS OF SATURATION OF SOLUTIONS AT HIGH TEMPERATURES BY THE GAMMA-RAY METHOD. Khaibullin, I. Kh.; Novikov, B. E. High Temp. (USSR) (Engl. Transl.); 10: No. 4, 805-807 (1972).

Translated from Teplofiz. Vys. Temp.; 10: No. 4, 895-897 (1972).

A gamma-ray method for determining the start of precipitation of salts from aqueous solutions at high pressures and temperatures is described. The essence of the method consists in recording the start of crystallization of the salts from aqueous solutions of a given composition on a heated surface with continuous determination of the change in the density of the medium during heating. Experiments were conducted with aqueous solutions of sodium sulfate. The experimental results permit recommending this method not only for recording the start of crystallization from solution, but also for determining the solubility of salts in water at high temperatures and high pressures and the pressure-temperature-volume, and liquid phase concentration properties of saturated aqueous solutions. (LCL)

616 MACHINE FOR DETERMINING WEAR CURVES. Skorynin, Y. V.; Semenov, G. V.; Dubinets, A. M.; Novitskii, V. N. Meas. Tech. (USSR) (Engl. Transl.); 15: No. 8, 1269-1270(Aug 1972).

Translated from Izmer. Tekh.; 15: No. 8, 87(Aug 1972).

A machine for obtaining wear curves for metal parts using radiotracers is described. The friction testing machine can be used to measure wear of 5 to 15 mm square or cylindrical specimens. (TFD)

617 STUDY OF THE EFFECT OF PARTICULAR FACTORS ON THE EROSION OF A MOLD USING RADIOACTIVATION TECHNIQUES. Tarinski, I. Fonderie; 27: No. 311, 139-149(Apr 1972). (In French).

The theoretical principles behind quantitative studies of the erosion of metal molds are exposed. A test installation using ^{187}W as a radioactive indicator was developed. In order to simulate the 3 basic interactions between the liquid metal and the mold (flow, flow together with shock, and pure shock), test pieces made of sand mixed with a given quantity of stable W powder (20%) were used. The test piece was activated with neutrons and then introduced into the mold. A specially constructed detector was used to determine the total activity of the metallic sample. The relative error in the determination of the nonmetallic inclusions in the molding is less than ±5%. In order to study the erosion of the mold following an interaction with the liquid metal jet, silicon sand containing 6% (by weight) bentonite, 3% (by weight) water and 20% (by weight) powdered W was used. In this way, the effect of the nature of the metal flow on the erosion was studied together with the variations in the properties of the sand and the friability as a function of the pressure of the molding. The erosion of the mold decreases with increasing quantities of bentonite and increasing sand density. The least amount of erosion occurs with the finest sand. The erosion is also reduced when certain organic additions (dextrine and molasses) or minerals (20% marschalite or 20% chamotte) are incorporated. The effect of the nature of the metal cast (35 steel, 18-36 grey cast iron and Al-34 alloy), and the various coatings used (phenol resins, graphite, and marschalite) on the erosion of the mold was studied. (FR)

618 γ-IRRADIATION OF BEEF FAT. Effects on Odor Intensity and Rancidity. Kosaric, N.; Duong, T. B.; Svrcek, W. Y. (Univ. of Western Ontario, London). J. Food Sci.; 38: No. 3, 374-376(1973).

Odor intensity and rancidity of γ irradiated beef fat were studied at different experimental conditions. Temperature was found to be an important factor in reducing the odor intensity and in increasing the stability of fat. There exists a correlation between the odor intensity and the peroxide value of fat if antioxidants are not incorporated. The addition of antioxidants protects the fat from induced odor and the rancidity developed during and after irradiation. (auth)

619 STATISTICAL APPROACH TO THE SUBJECTIVE AND OBJECTIVE MEASUREMENTS OF ODORS INDUCED BY γ IRRADIATION OF BEEF FAT. Kosaric, N.; Duong, T. B.; Svrcek, W. Y. (Univ. of Western Ontario, London). J. Food Sci.; 38: No. 3, 369-373(1973).

Beef fat, extracted from commercial beef, was subjected to γ-irradiation and the intensity of the odor induced by irradiation was studied. A statistical approach was developed to evaluate the organoleptic data obtained by taste panel evaluation and to correlate this data with the results obtained by chromatographic analysis of the irradiated samples. A step-wise multiple regression analysis was developed and this technique was analyzed for validity and applicability. (auth)

620 PRODUCTION OF POLYMER FILMS BY EVAPORATION. White, M.; Luff, P. P. (to National Research Development Corp.). British Patent 1,298,453. 6 Dec 1972. Filed Date 2 Jan 1969. 4p.

A process is described for deposition of a polymer film on a cooled substrate comprising heating the polymer in vacuo in the presence of the substrate so as to deposit the polymer thereon, and simultaneously irradiating the polymer with radiation of sufficient energy to induce cross-linking. Irradiation may be continued for a sufficient time to procure optimum mechanical properties in the polymer film. The irradiation may be UV, equivalent to at least 4 eV. A list of suitable polymers is given. The heating temperature may be 340 to 360°C, and the pressure of the order of 10^{-5} torr. The process may be applied to the production of thin film capacitors, and optically transparent protective overlays. (UK)

621 METHOD FOR THE IRRADIATION OF FOOD. Gruenewald, T. German Patent 1,492,618. 17 Aug 1972. 3p. (In German).

A procedure for the irradiation of food, meat in particular, with a combined treatment consisting of particle and electromagnetic radiation is described. The two types of radiation are combined by placing an anticathode especially designed for this purpose into the radiation path of an electron gun so that part of the particle radiation is transformed into bremsstrahlung. This anticathode consists of a plate with special openings which can be changed in diameter. Thus the radiation dose can be determined at will and adapted to the various kinds of food. The procedure has not yet been officially approved in the FRG. (GF)

622 RADIOIZOTOPNYE PRIBORY V PISHCHEVOI, LEGKOI I TSELLYULOZNO-BUMAZHNOI PROMYSHLENNOSTI. (Radioisotopic Apparatus in the Foodstuffs, Light, and Cellulosic Paper Industries). Pertsovskii, E. S.; Sakharov, E. V. Moscow; Atomizdat (1972). 232p.

The use of radioisotope devices for the control of manufacturing processes in the foodstuff industry, cotton processing, finishing, tanning, and glass manufacture is surveyed. Recommendations are given for organizing such operations and the optimum utilization of isotopic sources. The economics of installing such devices and the anticipated efficiency in their use are discussed. 247 references. (KSW)

LIFE SCIENCES

Radiation Effects on Biochemicals

Refer also to abstracts 214, 643, 706, and 720.

623 (LA-5227-PR, pp 12-26) MOLECULAR RADIOBIOLOGY SECTION. Mar 1973.

Annual report of the Biological and Medical Research Group (H-4) of the LASL Health Division, January–December 1972.

Radiobiological mechanisms for inception, progress, and repair of radiation damage are being studied. The action of ionizing radiation on DNA in anaerobic solution was studied with primary attention focused on radiation damage occuring at constant dose but with changing concentration of target molecule in order to find out the mechanism of damage. Some data that suggest concomitant direct and indirect action for both base damage and chain breaks. In studies of effects of radiation on genetic information transfer investigations on x-irradiated RNA polymerase were continued. The D_{37} values observed for inactivation of enzymatic activity varied with different template molecules used in the assay. In some cases, observed inactivation also was dependent upon substrate concentration. Separate studies of the effects of x irradiation on the ability of RNA polymerase to bind templates, to initiate RNA chains, and to add onto chains already started, led to the conclusion that the initiation step is the most sensitive to x irradiation, and that x-irradiated RNA polymerase has a greater tendency to insert the wrong base into RNA than does unirradiated enzyme. Evidence that ultraviolet irradiation produces covalent bonds between RNA polymerase and DNA was obtained and the utility of this reaction in the isolation of DNA binding sites was investigated. Experiments clearly demonstrated that structural alterations of histones by acetylation, methylation, and phosphorylation occur at defined times within the cell cycle of cultured mammalian cells. The effects of ionizing radiation on these reactions in cultured cells showed that, with the decline of DNA and histone biosynthesis several hours post-irradiation, histone acetylation and methylation cease. Results of these studies support the hypothesis that radioinduced division delay results from a blockage of cells in the G_2 portion of their life cycle. In order to test the hypothesis that irradiation of mammalian cells destroys a component or potential for division, standard microtubule assays were adapted for use with cultured cells. Investigations established the temporal pattern of intracellular microtubule protein levels in synchronized cultures of mammalian cells. Evidence was obtained to indicate that the levels of microtubule protein in x-irradiated cells follow closely that of other functional proteins. (CH)

624 (LA-5227-PR, pp 27-60) CELLULAR RADIOBIOLOGY SECTION. Mar 1973.

Annual report of the Biological and Medical Research Group (H-4) of the LASL Health Division, January–December 1972.

The relevance of specific biochemical features to regulatory and control mechanisms during the various stages of the cell cycle was studied in cultured mammalian cells and bacterial-phage systems. Evidence is presented that cytoplasmic mammalian messenger RNA exists as a nucleoprotein, not as free RNA, prior to association with ribosome. Mammalian RNA species were characterized by identification of minor bases. Data are included from studies on the effects of x radiation on histone metabolism in relation to DNA synthesis during the different phases of the cycle of mammalian cells and the effects of uv radiation on replication and excision repair of phage DNA following depression during prophage in Hemophilus influenzae and exposure in Escherichia coli. (CH)

625 EFFECTS OF γ RADIATION ON THE STAINING OF GLYCOSAMINOGLYCANS WITH ALCIAN BLUE. Morgan, R. E. (Univ. of Alabama, Birmingham); Moore, J. S.; Phillips, G. O. J. Histochem. Cytochem.; 20: No. 10, 831-832(Oct 1972).

Alcian Blue is currently one of the most widely used cationic dyes for the demonstration of glycosaminoglycans (GAG) in tissue sections. The mechanism of action of this staining appears to be the formation of a reversible electrostatic bond between the cationic dye molecules and the anionic sites on the GAG. These electrostatic bonds may be broken in the presence of added electrolyte and, furthermore, the amount of electrolyte required to break the bonds appears to vary between different types of GAG. The concentration of added electrolyte required to break the bonds between the cationic dye and the anionic sites on the GAG is usually referred to as the critical electrolyte concentration (CEC) and has served as the basis of the methods developed to differentiate between the various types of GAG. Since it is known that ionizing radiation depolymerizes GAG, the effect of γ irradiation on the CEC of various GAG in solutions when stained with Alcian Blue was investigated. (ERB)

626 ACTION OF IONIZING RADIATIONS ON HEPATIC GLUCOSE-6-PHOSPHATE DEHYDROGENASE, GLUCOSE-6-PHOSPHATASE, AND LACTATE DEHYDROGENASE IN THE MOUSE. Ghizari, E.; Culina, F. Rev. Roum. Physiol.; 10: No. 1, 79-84(1973). (In French).

The action of different single doses of x rays (50, 100, 250, and 500 R) on hepatic glucose-6-phosphate dehydrogenase (G-6-P-D-ase), glucose-6-phosphatase (g-6-P-ase), and lactate dehydrogenase (LDH) from mice was studied the first five days after irradiation. The results obtained have demonstrated that their behavior is different. The activity of G-6-P-D-ase is accelerated by large doses of x rays and inhibited by small doses. However, the inhibition of 250 R is reversible whereas the dose of 500 R behaves paradoxically manifesting itself by an activation the first five hours followed by a small inhibition to the end of the time of the study. The G-6-P-ase behaves differently. The small doses, after a slight inhibition, activate the enzyme starting with 24 hrs. The 250 R dose, after a primary activation, inhibits the enzyme after 24 hrs. The 500 R dose exercises a large inhibition to be followed on the third day by an activation of the enzyme that becomes the initial activity the fifth day. So far as the activity of the LDH is concerned, small doses in the same manner as the 250 R dose activate the enzyme the first five hours. On the contrary, the 500 R dose shows a large inhibition the first 24 hrs. The third day after the irradiation the enzyme regains its normal activity at all doses used. (tr-auth)

627 EFFECT OF INHIBITION OF MACROMOLECULE SYNTHESIS ON THE ASSOCIATION OF BACTERIOPHAGE T4 DNA WITH MEMBRANE. Earhart, C. F.; Sauri, C. J.; Fletcher, G.; Wulff, J. L. (Univ. of Texas, Austin). J. Virol.; 11: No. 4, 527-534(Apr 1973).

The "Mg^{2+}-Sarkosyl crystals" (M band) technique distinguishes between membrane-bound and free intracellular DNA. This procedure was employed to investigate the nature of the reactions necessary to convert input T4 DNA to a rapidly sedimenting form. Energy poisoning such as in iv irradiation inhibits this attachment reaction. Neither protein nor DNA synthesis appears to be required, but experiments with rifampin and extensively irradiated T4 suggest that RNA synthesis is involved. These results were confirmed by a second procedure for the determination of rapidly sedimenting DNA. (auth)

628 ESR STUDIES OF RADIATION DAMAGE IN SUBSTITUTED PYRIMIDINES: BARBITAL, AMOBARBITAL, AND APROBARBITAL. Haak, R. A. Carbondale, IL; Southern Illinois Univ. (1972). 116p. University Microfilms Order No. 73-6209.

Thesis (Ph. D.).

The 5-position substituted barbituric acid derivatives, barbital, amobarbital, and aprobarbital, are used as a model system to study the effects of molecular structure and crystalline environment of radical formation. The barbital radical was studied in the different environments found in the barbital crystal polymorphs I, II, and IV, and in sodium barbital. A room-temperature-stable free radical is formed in single crystals of barbital II by abstraction of an ethyl from the 5-position. The unpaired electron couples equally to the two methylene protons in the remaining ethyl. A 13° reorientation of the damaged molecule in the crystal structure was observed. The unpaired spin density on C(5) was determined to be 0.4, with the remaining density divided equally between O(4) and O(6). Irradiated barbital I and IV single crystals contained a radical identical to the barbital II radical. A reorientation was also observed in barbital I. Unpaired spin densities at C(5) in I and IV were also 0.4. A radical was formed in amobarbital by an abstraction of either an ethyl or an isoamyl group from C(5). Consideration of the crystal structures and the fact that the unpaired spin density on C(5) is 0.4 indicate that the radical formed by an isoamyl abstraction is more probable than the ethyl abstraction radical. A radical observed in aprobarbital at low doses showed a doublet ESR spectrum. This radical may be formed either by hydrogen addition to O(4) or O(6), or by an allyl abstraction from C(5). Other radical species were also present that interfered with a complete analysis. These results indicate that the 5-position substituents affect both the delocalization of the unpaired electron and the radical formation process. Unpaired spin densities at C(5), indicative of the extent of delocalization, are reported to be 0.55 and 0.7 for OH and H 5-position substituents in alloxan and barbituric acid radicals, respectively. Dose studies were performed on polycrystalline barbital I, barbital

II, and sodium barbital. G values (radicals/100 eV absorbed) for polymorphs I and II were identical, while sodium barbital was higher by a factor of two. Maximum radical concentrations were similar in sodium barbital and barbital I, while barbital II was slightly lower. These results, when combined with the known crystal structure data and the single crystal ESR analyses, suggest that intermolecular forces can significantly affect measured radical characteristics, although the species of the radical formed seems largely determined by the undamaged molecular structure. The increase in radical kinetics observed in sodium barbital implicate the presence of the anionic form of barbital and the sodium cation as important parameters in radical formation processes. (Diss. Abstr. Int., B)

629 PYRIMIDINE ADDUCT FLUORESCENCE IN UV-IRRADIATED NUCLEIC ACIDS. Hauswirth, W.; Yang, S. Y. (Johns Hopkins Univ., Baltimore). AT(11-1)-3276. Biochem. Biophys. Res. Commun.; 51: No. 3, 819-826(2 Apr 1973). (COO-3276-4 (66)).

The fluorescence properties of the pyrimidine photoadducts were studied. The observation of similar spectra in uv-irradiated DNAs and polynucleotides implies that the formation of adducts may be monitored in biological systems by their emission signals. The fixed ratio of photochemical yields between adducts and other lethal products also suggests the use of adduct fluorescence to assay directly the degree of photodamage in DNA. (auth)

630 CONFORMATION MEASUREMENTS ON BOVINE TRYPSIN AND ALPHA-CHYMOTRYPSIN DURING PHOTODYNAMIC INACTIVATION. Hopkins, T. R.; Spikes, J. D. (Univ. of Utah, Salt Lake City). Contract AT(11-1)-875. Radiat. Res.; 53: No. 2, 315-325(Feb 1973).

Bovine trypsin and α-chymotrypsin were inactivated by photodynamic treatment in sodium phosphate buffer at pH 8 using methylene blue, eosin Y and FMN as sensitizers. Measurements sensitive to changes in protein conformation, in particular, tryptophan fluorescence, rates of unfolding in 8M urea, ion-exchange chromatography, and thermodenaturation kinetics were made on the enzymes during the course of inactivation. The tertiary structures of trypsin and chymotrypsin are altered as measured by these methods but the rates of change in conformation do not parallel the rates of loss of enzyme activity during photodynamic treatment. Further, active enzyme molecules produced by photodynamic treatment are more easily denatured by high concentrations of urea than is native enzyme. The necessity of ruling out effects on enzyme secondary and tertiary structure before interpreting photodynamic inactivation in terms of the photooxidation of critical amino acid residues in the active site region is demonstrated. (auth)

631 ELECTRON SPIN RESONANCE STUDIES OF γ-IRRADIATED DINUCLEOTIDES AND RELATED COMPOUNDS AT 77°K. Bernhard, W. A.; Danyluk, S. S. (Argonne National Lab., IL). Radiat. Res.; 53: No. 2, 169-180(Feb 1973). (UR-3490-125).

Polycrystalline samples of 19 dinucleotides, barium diethyl phosphate, and 3′-cytidylic acid were γ-irradiated and observed at 77°K by electron spin resonance. In 18 of the dinucleotides and barium diethyl phosphate a doublet having a hyperfine splitting of 117 to 124 G and g value (spectroscopic splitting factor) of 1.998 to 2.000 is observed. It was concluded that the doublet hyperfine interaction is due to ^{31}P. The free radical postulated to account for the observed doublet is $(RO)(R'O)PO_2$, with the unpaired electron localized on one or both of the nonester oxygens. A similar radical, $(HO)(RO)PO_2$, is the postulated assignment for the observed 145-G hyperfine doublet observed in 3′-cytidylic acid. Depending on the individual dinucleotide, the free radical giving rise to the 120-G doublet after a dose of ~10 MR accounts for from ~0.1% to ~5% of the total number of free radicals produced. (auth)

632 THEORY OF COOPERATIVE FORMATION OF INJURIES IN A BIOPOLYMER MOLECULE UNDER THE ACTION OF RADIATION. Frank-Kamenetskii, M. D.; Lukashin, A. V.; Vologodskii, A. V. (Inst. of Atomic Energy, Moscow). Dokl. Akad. Nauk SSSR; 208: No. 3, 721-724(21 Jan 1973). (In Russian).

General equations are offered that describe the cooperative formation of radiation damage to a linear, homogeneous chain molecule. Additional calculations were based on a model proposed by Shafranovskaya and others (1972). (KSW)

Radiation Effects on Cells

Refer also to abstract 642.

633 GENETICS OF STIMULATION OF IN VITRO HEMOLYTIC PLAQUE-FORMING CELL RESPONSES BY IRRADIATED ALLOGENEIC SPLEEN CELLS. Kennedy, J. C.; Ekpaha-Mensah, J. A. (Queen's Univ., Kingston, Ont.). J. Immunol.; 110: No. 4, 1108-1117(Apr 1973).

The addition of heavily irradiated spleen cells to cultures containing syngeneic spleen cells and foreign erythrocytes may stimulate to some extent the hemolytic plaque-forming cell responses of those cultures, but the addition of allogeneic irradiated spleen cells may cause much greater stimulation. Irradiated spleen cells from mice of various inbred strains were tested for their ability to produce such stimulation in cultures containing spleen cells from an allogeneic or congenic resistant partner. It was found that a genetic difference in the region of the K end of the H-2 locus was sufficient to cause strong reciprocal stimulation, while a difference in the region of the D end was not. Multiple non-H-2 histocompatibility differences were ineffective, with two interesting exceptions. It is suggested that reciprocal allogeneic stimulation of in vitro hemolytic plaque-forming cell responses may be a useful means of detecting major histocompatibility differences. A model for allogeneic stimulation is proposed. (auth)

634 DEFICIENT DNA REPAIR IN HUMAN PROGEROID CELLS. Epstein, J.; Williams, J. R.; Little, J. B. (Harvard Univ., Boston). Proc. Nat. Acad. Sci. U. S. A.; 70: No. 4, 977-981(Apr 1973).

Skin fibroblasts biopsied from a patient with clinical symptoms of the Hutchinson-Gilford progeria syndrome failed to show evidence of normal DNA strand rejoining in vitro after exposure to cobalt-60 gamma irradiation. Control human diploid fibroblasts of fetal origin in early passage, skin fibroblasts of adult origin, and an established line of human liver cells (LICH) all showed essentially complete rejoining of radiation-induced strand breaks within 30 min after irradiation, as evidenced by DNA sedimentation profiles in alkaline sucrose gradients. The results suggest that an enzyme involved in DNA repair may be absent or greatly reduced in efficiency in cells from this patient with the progeria syndrome. Such a repair-deficient cell strain may prove useful in the study of the molecular events associated with x-ray-type damage and its repair in mammalian cells. (auth)

635 QUANTITATIVE ASSAY FOR THE MIXED LEUKOCYTE REACTION BY MOUSE SPLEEN CELLS. El-Arini, M. O.; Osoba, D. (Univ. of Toronto). J. Immunol.; 110: No. 4, 926-933(Apr 1973).

A method for culturing mixtures of allogeneic mouse spleen cells which gives quantitative results is described. The kinetics of the response is reproducible from experiment to experiment and the dose-response curve is linear. Radiation survival studies indicate that the responding cells require the capacity to proliferate during the mixed-leukocyte reaction (D_{37} = 95 rads). From experiments with the spleen cells of congenic resistant strains it is evident that the response is controlled by minor histocompatibility loci as well as by the H-2 locus. (auth)

636 CELLULAR RADIOSENSITIVITY AND TUMOR RADIATION RESPONSE IN THE EMT6 TUMOR CELL SYSTEM. Rockwell, S.; Kallman, R. F. (Stanford Univ., CA). Radiat. Res.; 53: No. 2, 281-294(Feb 1973).

The radiation responses of EMT6 tumors and tumor cells were examined under a variety of experimental conditions. Survival curves for cultured EMT6 cells irradiated in vitro with 250 kV x rays under conditions of hypoxia and normal aeration were characterized by D_0's of 467 and 155 rad and extrapolation numbers of 3.0 and 2.8 (oxygen enhancement ratio = 3.0). Survival curves of EMT6 cells suspended from solid tumors after irradiation in situ showed the biphasic shape predicted for a mixed population of oxygenated and severely hypoxic cells. Comparison of the survival of cells suspended from tumors irradiated in situ in air-breathing and nitrogen-asphyxiated mice showed the hypoxic fraction of the tumor to be 0.33. The radiation sensitivity of tumors remaining in situ after irradiation, assayed by tumor growth perturbation or by tumor cure, was greater than expected on the basis of the cell survival curves. This was ascribed to tumor-host interactions including immune recognition of the irradiated tumor. (auth)

637 RADIATION-INDUCED CYCLE DELAY IN SYNCHRONIZED CHINESE HAMSTER CELLS: COMPARISON BETWEEN DNA SYNTHESIS AND DIVISION. Leeper, D. B.; Schneiderman, M. H.; Dewey, W. C. (Colorado State Univ., Fort Collins). Contract AT(11-1)-1086. Radiat. Res.; 53: No. 2, 326-337(Feb 1973).

Chinese hamster ovary fibroblasts (MI > 90%) were synchronized by mitotic selection and x-irradiated at two-hour intervals during the cell cycle with 150, 300, or 600 rad. Cell progression was monitored by pulse labeling with [^{3}H]TdR at one-hour intervals, followed by autoradiography and liquid scintillation counting. Irradiated mitotic and G_1 cells were delayed in initiating DNA synthesis (0.4 to 2.7 hr), but the rate of entry into and out of S, the

duration of S, and the rate of DNA synthesis remained unchanged. Cells irradiated during S incorporated [^{3}H]TdR at a reduced rate and were delayed in entering G_2. The fraction of cells capable of entering S was not reduced by any time-dose combination. The delay in entering and leaving the S phase, which resulted from a dose of 150 or 600 rad was about 40% of that from 300 rad. The division delay, however, increased linearly with dose and exponentially with cell age. The ratio of division delay to S delay for G_1 cells irradiated with 150 and 300 rad was approximately one. However, after irradiation at all other time-dose combinations, the ratio was considerably greater than one, indicating the existence of a G_2 block responsible for division delay. A possible relationship between radiation-induced S delay and a defect in translation is discussed. (auth)

Radiation Effects on Microorganisms

Refer also to abstracts 613 and 709.

638 EFFECT OF GAMMA RADIATION ON D-GLUCOSE PRESENT IN APPLE JUICE. Baraldi, D. (CNEN, Rome). J. Food Sci.; 38: No. 1, 108-111(Jan 1973).

An attempt was made to separate and identify the degradation products of gamma-irradiated D-glucose present in apple juice. C-14 uniformly labeled D-glucose was added to the juice. After irradiation with a dose of 1 Mrad, the neutral organic fraction was separated from the acid fraction using an exchange resin in the carbonate form. Both fractions were then investigated by means of thin-layer chromatography, paper chromatography, and autoradiography. Up to 11 components were found in the acidic fraction as degradation products of D-glucose; among them gluconic, glucuronic, and glycolic acids. No radioinduced aldehyde or ketone compounds were found. Experiments carried out to detect glyoxal and other dialdehydes were negative. (auth)

639 APPLICATION OF LOW DOSE IRRADIATION TO A FRESH BREAD SYSTEM FOR SPACE FLIGHTS. Hartung, T. E.; Bullerman, L. B., Arnold, R. G.; Heidelbaugh, N. D. (Univ. of Nebraska, Lincoln). J. Food. Sci.; 38: No. 1, 129-132(Jan 1973).

Irradiation pasteurization of flour and bread at 50,000 rads markedly reduced their microflora. Irradiation pasteurization of bread in combination with the irradiated flour extended the period of freedom or low incidence of mold growth when stored at 21 to 25°C, improving the use of fresh bread for flights having several weeks duration. The irradiation process reduced the presence of the mold genera Aspergillus and Penicillium, which suggests an advantage when considering potential toxic metabolites that may result from mold growth. Chemical measurements, involving TBA value, gas chromatography of bread volatiles, and infrared scanning of the bread lipids, did not show any major influences due to the irradiation process. Irradiated white bread samples after short term storage contained a new carbonyl group identified in the infrared scan that was not noted in the control white bread. This same compound, tentatively identified as propionaldehyde, appeared after 12 weeks in nonirradiated white bread. Panel evaluations were unable to distinguish aroma, appearance, flavor, texture or freshness differences attributable to the irradiation process used in this study. Within the type of bread specified by NASA, no general detrimental quality changes were observed due to the irradiation treatments used. Overall the results support the application of low dose irradiation in the extension of mold-free fresh bread for space flights. (auth)

640 SPORE COLOR MUTANTS INDUCED BY γ IRRADIATION IN TRICHODERMA GLAUCUM ABBOTT. Nene, Y. L. (Univ. of Agriculture and Tech., Pantnagar, India). Curr. Sci. (India); 42: No. 8, 293-294(20 Apr 1973).

Growth characteristics of three spore color mutants of Trichoderma glaucum, obtained by γ irradiation, are reported. The light green and yellow mutants were slow growing and the white mutant fast growing in comparison to the wild type. (ERB)

641 TEXTURAL CHANGES IN PRECOOKED LOBSTER (HOMARUS AMERICANUS) MEAT RESULTING FROM RADURIZATION FOLLOWED BY REFRIGERATED STORAGE. Dagbjartsson, B.; Solberg, M. (Rutgers–The State Univ., New Brunswick, NJ). J. Food Sci.; 38: No. 1, 165-167(Jan 1973).

The textural changes of radurized precooked lobster meat were evaluated by the organoleptic chew count method and the Warner–Bratzler shear test. Significant texture toughening resulted from irradiation with 100 Krads whereas at 75 Krads the changes were not significant. The texture did not change significantly during post-irradiation storage at refrigeration temperatures. (auth)

642 CONTINUOUS PROPAGATION OF RADIATION LEUKEMIA VIRUS ON A C57BL MOUSE-EMBRYO FIBROBLAST LINE, WITH ATTENUATION OF LEUKEMOGENIC ACTIVITY. Lieberman, M.; Niwa, O.; Decleve, A.; Kaplan, H. S. (Stanford Univ., CA). Proc. Nat. Acad. Sci. U. S. A.; 70: No. 4, 1250-1253(Apr 1973).

The radiation leukemia virus (RadLV), a murine leukemia virus derived from thymic lymphomas induced by x irradiation in strain C57BL/Ka mice, was successfully propagated in sustained high titer in vitro in a newly established line, BL-5, of C57BL/Ka mouse-embryo fibroblasts. In addition, the production of endogenous virus, presumed to be RadLV, was induced and sustained through multiple serial passages after treatment of BL-5 cell cultures with 5-bromodeoxyuridine. The chronically RadLV-infected subline, designated BL-5 (RadLV), sheds virus into the supernatant culture fluids that is biologically active in vitro in the XC cell plaque assay, in interference assays for focus-formation by murine sarcoma virus, and in the intracellular induction of group-specific antigens detectable by immunofluorescence, but is apparently devoid of leukemogenic activity after intrathymic inoculation into neonatal or immunosuppressed C57BL/Ka mice. Although BL-5 cells exhibited morphological alterations suggestive of transformation in vitro and gave rise to fibrosarcomatous ascites tumors after intraperitoneal inoculation with C57BL/Ka mice, the chronically infected BL-5(RadLV) cells remained normal in morphology and failed to yield fibrosarcomas in vivo. (auth)

643 SYNTHESIS OF BACTERIOPHAGE-CODED GENE PRODUCTS DURING INFECTION OF ESCHERICHIA COLI WITH AMBER MUTANTS OF T3 AND T7 DEFECTIVE IN GENE 1. Issinger, O. G.; Hausmann, R. (Univ., Frieburg i. B.). J. Virol.; 11: No. 4, 465-472(Apr 1973).

During nonpermissive infection by a T7 amber mutant in gene 1 (phage RNA polymerase-deficient), synthesis of the products of the phage genes 3 (endonuclease), 3,5 (lysozyme), 5 (DNA polymerase), and 17 (serum blocking power) was shown to occur at about half the rate as during wild-type infection. In contrast to T3 gene 1 mutants, the T7 gene 1 mutants directed the synthesis of phage DNA during non-permissive infection. This DNA accumulated as a material sedimenting faster than mature T7 DNA. DNA synthesis was inhibited by ultraviolet irradiation of the host E. coli. (MCG)

644 VIABILITY OF BACTERIOPHAGE T_4 AFTER IRRADIATION OF ONLY THE HEAD COMPONENT OR THE TAIL COMPONENT. I. In Nutrient Broth Projected Conditions. Clarkson, C. E.; Dewey, D. L. (Mount Vernon Hospital, Middlesex, Eng.). Radiat. Res.; 53: No. 2, 248-254(Feb 1973).

Amber mutants of bacteriophage T_4D were used to study the relative radiosensitivity of the head component and of the tail component of the phage under various experimental conditions. In the presence of radical scavenging agents the protein tails were considerably less sensitive to ionizing radiation than the intact, whole phage, whereas the DNA-containing heads were slightly more sensitive than whole bacteriophage. The Do (37% survival) of anoxic tails was 900 krad and 26 krad for heads. Addition of cysteamine reduced the radiosensitivity of phage heads and whole phage but had no effect on the tails. Likewise oxygen had a protective effect on the heads and whole phage but did not alter the radiosensitivity of the tails. Irradiation had no effect on the in vitro assembly method used for measuring the heads and tails. (auth)

645 REPAIR MECHANISMS AND CELL CYCLE DEPENDENT VARIATIONS IN X-RAY SENSITIVITY OF DIPLOID YEAST. de Langguth, E. N.; Beam, C. A. (Brooklyn Coll., NY). AT(30-1)-3998. Radiat. Res.; 53: No. 2, 226-234(Feb 1973).

Diploid yeast cells of different cell ages were compared with respect to their x-ray sensitivity on immediate plating (IP) and after liquid holding (LH) treatment in the presence and absence of caffeine. Response following IP can be divided into sensitive and resistant periods each occupying 50% of the cell cycle. The sensitive period includes postbudding, mother–daughter cell separation and early interdivisional cells. Resistance begins in later interdivisional cells and maximizes during early budding. LH obliterates the differences seen with IP. The more sensitive the cell is on IP, the more it responds to LH, with the result that all cells show the same survival, which is essentially that of the most resistant budding cell on IP. Caffeine, though without effect on IP survival, reduces the LH survival of all cells of the IP level of prebudding interdivisional cells. These findings are interpreted as resulting from the regulated oscillation during the cell cycle of at least two repair pathways, both of which can also be evoked by LH. (auth)

646 POST-IRRADIATION DNA DEGRADATION IN MICROCOCCUS RADIODURANS, STRAIN $R_{II}5$. Auda, H.; Emborg, C. (Atomic Energy Commission, Baghdad). Radiat. Res.; 53: No. 2, 273-280(Feb 1973).

The influence of conditions of irradiation on post-irradiation DNA degradation was studied in a radiation resistant mutant of M. radiodurans, strain $R_{II}5$. After irradiation with 1 Mrad or

higher more DNA is degraded in cells irradiated in wet condition than in cells irradiated with the same doses in dry condition. Cells irradiated with 2 Mrad degrade 60% of the DNA after irradiation in wet condition, 45% of the DNA after irradiation in dry condition. In cells irradiated with 1.5 and 2 Mrad in wet condition the rate of degradation is lower than after irradiation in dry condition. (auth)

647 EFFECT OF RADIOSENSITIZING AGENTS ON DNA STRAND BREAKS AND THEIR RAPID REPAIR DURING IRRADIATION. Myers, D. K.; Chetty, K. G. (Chalk River Nuclear Labs., Ont.). Radiat. Res.; 53: No. 2, 307-314(Feb 1973).

The number of strand breaks in the DNA of bacteriophage T4 and of three strains of Escherichia coli was measured after exposure to γ radiation in the presence and absence of radiosensitizing agents. Little effect of these agents on break production was observed with intact bacteriophage. Both sensitization and protection were observed with different agents when the phage was lysed to expose the DNA before irradiation. Both effects were attributed to interactions with the OH radicals produced in the irradiated solution. However, these effects did not appear to play an important role in the production of DNA strand breaks during the irradiation of intact E. coli cells. The presence of iodate, iodoacetamide, or N-ethyl maleimide during irradiation inhibited the DNA polymerase I-dependent repair of single-strand breaks in the DNA. No effect of these compounds was observed with E. coli pol A cells, which lack this rapid repair system. Mild detergents also inhibited the rapid repair of strand breaks. It was concluded that the radiosensitizing agents affect DNA repair in intact E. coli cells and that the main target of their action under the conditions used is probably the cell membrane. (auth)

648 TOXICITY OF IRRADIATED 1-NAPHTHOL. Bruce, A. K.; Mahoney, G. F.; Gersten, D. M.; Thomas, C. C. Jr. (State Univ. of New York, Buffalo). Radiat. Res.; 53: No. 2, 295-306 (Feb 1973).

Irradiation of bacteria in the presence of 1-naphthol produces a radiosensitization. The magnitude of the response is dependent on cell concentration and type, and requires an extended incubation in the irradiated medium. Irradiation of 1-naphthol yields both 1,2- and 1,4-naphthoquinone. Synthetic mixtures of these agents at concentrations equivalent to those produced by 40 kR irradiation demonstrate the required level of toxicity. Cells accumulated like amounts of these agents from either irradiated 1-naphthol or from mixtures with toxicity related to this accumulation. The mechanism of this sensitization in terms of sulfhydryl interaction and electron transport interference is discussed. (auth)

649 EFFECT OF LIQUID HOLDING IN SCHIZOSACCHAROMYCES POMBE STRAINS AFTER GAMMA AND ULTRAVIOLET IRRADIATION. Shahin, M. M.; Gentner, N. E.; Nasim, A. (Chalk River Nuclear Labs., Ont.). Radiat. Res.; 53: No. 2, 216-225 (Feb 1973).

The effect of liquid-holding after γ and uv irradiation was investigated in three different strains of Schizosaccharomyces pombe: the haploid wild type 972 h^-, the diploid h^-/h^- and the radiation-sensitive strain UVS-1 h^-. It was found that the diploid strain is only slightly more resistant to inactivation by both γ and uv irradiation compared to the haploid wild type. For liquid-holding experiments various non-nutrient solutions were examined and two that yielded minimal spontaneous cell death were chosen as favorable for all subsequent studies. These experiments have shown that: the haploid wild type exhibited negative liquid-holding effect (NLHE) after γ irradiation, similar to that reported previously for uv irradiation; the diploid strain showed NLHE after both γ and uv irradiation; the rate of NLHE, for a given dose, was similar to that for the haploid strain; for both haploid and diploid strains the rate of NLHE increased with increasing dose of either γ or uv irradiation; the radiation-sensitive strain UVS-1 h^-, for which liquid-holding recovery (LHR) following uv irradiation has been reported, did not display LHR after γ irradiation; the pH of the two non-nutrient solutions used (pH 4.8 and 7.0), had no effect on the LH response of any of the three strains. (auth)

650 NEW INTERNATIONAL FOOD IRRADIATION PROJECT. Diehl, J. F. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.). Proc. Jap. Conf. Radioisotop.; No. 10, 112-116(Apr 1972).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

A new international agreement for the investigation of food irradiation was signed by 19 countries in October 1970. Two more countries have joined the agreement this year. The project comprises the following activities: (1) wholesomeness test of irradiated food; (2) research on and investigation into the methodology of the wholesomeness test; (3) dissemination of information; and (4) assisting national and international authorities in their consideration of the acceptance of irradiated food. The annual budget is $275,000 (US), 54% of which is spent for wholesomeness test contracts. The work contracted so far is vitamin analysis on the bread from irradiated wheat; tests on irradiated wheat flour baked into biscuits fed to mice; irradiated potatoes, cooked and fed to rats; and irradiated potatoes, cooked and fed to mice. (MCG)

Radiation Effects on Plants

Refer also to abstracts 387 and 650.

651 (UR-3490-205) FURTHER MULTIPLE FIXATION CHROMOSOME ABERRATION DOSE FRACTIONATION STUDIES ON VICIA FABA: THE EFFECT OF CYCLOHEXIMIDE. Miller, M. W.; Weiss, C. (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). 1972. 25p. Dep. NTIS $3.25.

Soaked seeds of Vicia faba were x irradiated with 800 or 400 R, or two 400 R exposures, both with vacuum but one with a concomitant treatment of cycloheximide (1 μg/ml). The chromosome aberration yields from each regimen varied with fixation time such that a unique and characteristic aberration yield for each regimen relative to the others was not obtained. Were single fixations employed one could obtain yields which would indicate no, some, or maximum repair. A single fixation would lead to an incorrect estimation of chromosome damage repair. (auth)

652 ROLE OF CELLS AND CHROMOSOMES IN RADIOBIOLOGICAL CHANGES IN WINTER RYE. Pomogaibo, V. M. Tsitol. Genet.; 6: No. 4, 306-308(1972). (In Russian).

It was established that in winter rye seeds under the effect of modifying factors (storage, moisture, etc.) the character of injurious effect of γ rays and fast neutrons changes both in cells (frequency of cells with chromosome aberrations) and in chromosomes (number of aberrations per injured cell). The supposition is made that modifications of the radiation effects are due to chromosomes. (auth)

653 OBTAINING SOMATIC MUTATIONS IN POTATO (SOLANUM TUBEROSUM L.) BY ELECTRON, X-RAY, AND γ-IRRADIATIONS. Mezentsev, A. V. Tsitol. Genet.; 6: No. 4, 309-312(1972). (In Russian).

Accelerated electrons (18 to 20 kR), x, and γ rays (3.5 kR) induced approximately the same frequency of recessive mutations in tuber coloration of the variety Volzhsky. Dominant mutations in the variety Lorkh appeared only after irradiation with electrons (14 and 24 kR). (auth)

654 INDUCTION OF USEFUL MUTATIONS IN MULBERRY AND ROSES BY MEANS OF γ IRRADIATION. Nakajima, K. (Sericultural Experiment Station, Tokyo). Proc. Jap. Conf. Radioisotop.; No. 10, 368-370(Apr 1972). (In Japanese).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

Problems on the radiation breeding of mulberry and roses are discussed, taking notice of methods for the induction of useful mutations and characteristics of the mutations. Lateral branches of the mulberry grown by cutting at different three points in July, after the irradiation with γ-rays of 7.5 kR (5kR/hr) in mid April, showed bud mutation of leaf shape and leaf color at the rate of 1.3%, 4.3%, and 3.8%, respectively. Among the useful mutations of the roses, in which superiority and rarity of color and shape change in the course of time, a currently admired useful mutation is as follows: a mutation series was obtained from the rose species, Peace, by the irradiation of 8 kR (800R/day). A mutation series was obtained by the irradiation of 11 kR (1000R/day) to the V18 which resulted from the Peace by 5.9 kR (1180R/day) irradiation. Both V75 and V77 were induced from the rose species Queen Elizabeth. (Japan)

655 INITIAL PROCESSES CAUSED IN PLANTS BY THE ACTION OF IONIZING RADIATION. Kuzin, A. M. (Inst. of Biophysics, Pushchino, USSR). Izv. Akad. Nauk SSSR, Ser. Biol.; No. 4, 495-502(1971). (In Russian).

Data suggested that radiation damage in plants was due to direct action of radiation on the genome and to the indirect influence of radiotoxins on the genome. A relationship was observed between radiotoxins, natural growth inhibitors, and mutagens. During radiation damage to plants, an increase in the amount of radiotoxins as growth inhibitors and a simultaneous decrease in the amount of growth stimulants, such as auxins and gibberellic acid, take place, thus causing a disturbance of the equilibrium between the two groups of factors. In the absence of such equilibrium, normal

growth and development of plants and plant organs is impossible. (HLW)

656 EXPERIMENTAL γ-RAY INDUCED MUTATIONS IN PEA. Kartashova, N. N.; Tsitlenok, S. I.; Bondar, L. M.; Dubrova, N. A. (Tomsk State Univ., USSR). Tsitol. Genet.; 6: No. 4, 313-316(1972). (In Russian).

The frequency and spectrum of chlorophyll mutations induced by γ rays are considered in peas of four varieties at different phenological stages of plant development. It was found that during early stages of development chlorophyll mutants are lethal and not numerous in the spectrum. The greatest frequency and spectrum of mutants are observed at the flowering phase when lethality considerably decreases. The chlorophyll mutants are not formed when the flowering period is over. (auth)

657 INDUCTION OF BUD MUTATIONS OF APPLES BY γ IRRADIATION. Nishida, T. (Inst. of Radiation Breeding, Omiya, Japan). Proc. Jap. Conf. Radioisotop.; No. 10, 365-367(Apr 1972). (In Japanese).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

The effect of gamma rays on the induction of mutation of apple buds was studied. The most effective method of irradiation to obtain the useful bud mutation was searched. Two-year-old grafted seedlings of eight species of apple were planted in a gamma field. Irradiation of high dose rate tended to be advantageous to obtain the mutation. However, the high dose rate was apt to yield chromosome aberrations. Thus, the irradiation of high and low dose rate have their advantages and defects, respectively. The apples planted in the gamma field have been irradiated for about ten years, and total dose amounted to 21.2 to 6.7 KR. In spite of the dose amount, the bud mutation found was not much. Eleven cases of bud mutation were found among 87 trees now living. Most mutations turned out to be chimera structure, i.e., five sectorial chimeras and three periclinal chimeras. These bud mutations showed a clear variation in leaf color, leaf shape, and vegetation habit. (Japan)

658 SPROUT INHIBITION OF POTATOES BY IRRADIATION. Umeda, K. (Food Research Inst., Tokyo). Proc. Jap. Conf. Radioisotop.; No. 10, 417-418(Apr 1972). (In Japanese).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

Potatoes were irradiated by ^{60}Co gamma rays. The irradiated potatoes were more suited to being served without processing. Unirradiated potatoes are suited in the case of processing to potato chips. The processed or unprocessed potatoes stored at normal temperature are superior from every point to those kept in cold storage. The unirradiated potatoes stored at normal temperature almost sprout in long-term storage. Thus, the irradiated potatoes stored at normal temperature and the unirradiated ones kept in cold storage should be compared. In order to decrease reducing sugar, potatoes are stored at normal temperature (about 15°C) for two weeks before processing. In this case, the irradiated potatoes stored at normal temperature do not sprout, while the unirradiated ones kept in cold storage begin to sprout immediately. It is concluded that storage at normal temperature after the irradiation is most practical. In terms of quality and cost, it is appropriate to store the potatoes from winter to spring at normal temperature after the 7 to 15 krad irradiation. (Japan)

659 NUTRITIVE VALUE OF IRRADIATED POTATOES. Takai, Y.; Iwao, H.; Shimomura, H. (National Inst. of Nutrition, Tokyo). Proc. Jap. Conf. Radioisotop.; No. 10, 410-413(Apr 1972). (In Japanese).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

Two experiments are reported on the effect of ^{60}Co gamma rays on the change of ingredient and tissue of stored potatoes and the effect of the irradiated potatoes on the human body. The change of the nutritive ingredient of potatoes stored after the 7000; 15000; and 30000-R irradiation by ^{60}Co gamma rays was measured periodically. No effect was observed after the 7000- and 15000-R irradiation. The potatoes irradiated by 30000 R became harder than unirradiated ones after they were boiled. The effect of irradiation on the tissue was different according to the amount of dose, i.e., the greater the dose, the deeper the depth of effect. No effect of the irradiation was seen on the growth and metabolism of rats when they were fed with the irradiated potatoes. (Japan)

660 EFFECT OF CHRONIC GAMMA IRRADIATION ON THE NODULATION OF VIGNA CATJANG. Murthy, N. B. K.; Mahajan, B. A. (Bhabha Atomic Research Centre, Trombay, India). Curr. Sci. (India); 42: No. 8, 295-296(20 Apr 1973).

Seedlings of Vigna catjang were γ-irradiated for 12 hrs daily for 4 weeks at dose rates of 12.5, 25, 50, and 100 R/hr. After 4 weeks, the number of nodules on the roots was determined as was seedling height. There was an increase in the number of nodules on seedlings irradiated at 12.5, 25, and 50 R/hr over that of the controls. At 100 R/hr, the number of nodules decreased. Seedling height was significantly reduced by all treatment levels compared to controls. Nitrogen content of the seedlings was increased over that of the controls at all treatment levels. (ERB)

661 COMBINED EFFECT OF X-RAY AND UV-IRRADIATION ON THE CONTENT OF ASCORBIC ACID IN PLANTS. Kezeli, T. A.; Gvamichava, N. E.; Tarasashvili, K. M.; Piranishvili, N. S. Soobshch. Akad. Nauk Gruz. SSR; 69: No. 3, 665-667(Mar 1973). (In Georgian).

The growth of wheat radicles and grapevine cuttings is retarded by the action of x-rays (1000 to 3000 R), the formation of ascorbic acid being suppressed as well. Additonal irradiation with uv rays ($15 \cdot 10^5$ erg/sq cm to $31 \cdot 10^5$ erg/sq cm) immediately after x-ray irradiation restores the growth of plants and the accumulation of ascorbic acid in them. (auth)

662 INDUCTION OF MUTATIONS IN OIL YIELD OF LINALOOL TREE (CINNAMOMUM CAMPHORA SIEB. VAR. LINALOOLIFERA FUJITA). Hayashi, K. (Kochi, Univ., Japan). Proc. Jap. Conf. Radioisotop.; No. 10, 371-373(Apr 1972). (In Japanese).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

Induction of mutations in the oil yield of linalool trees by slow and rapid irradiation by gamma rays was studied, especially the rapid irradiation to seeds and young trees. Visible bud mutation with large sector and the induction of mutation in oil yield seemed to be obtained by the 5- to 10-kR irradiation to seeds. Although at most 8 kR of irradiation to young trees is possible in spring and autumn, injury to the oil yield is conspicuous, i.e., examination after three years from the irradiation is necessary. One visible mutation and a few mutations in the oil yield were induced in this experiment. (Japan)

663 BIOCHEMICAL AND MICROBIOLOGICAL EFFECT OF IRRADIATION ON POTATOES. Okazawa, Y. (Inst. of Physical and Chemical Research, Wako, Japan). Proc. Jap. Conf. Radioisotop.; No. 10, 419-421(Apr 1972). (In Japanese).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

Potatoes irradiated differently below 30 krad and stored under different conditions were compared, in order to study the biochemical and microbiological effects of irradiation for sprout inhibition. The irradiation of potatoes immediately after harvest often results in a brown coloring of the vascular bundle. This can be avoided by irradiation two months after harvest of fully ripe tubers. Respiration of the tubers at normal temperature shows a rapid increase temporarily after irradiation. The activity of peroxidase and polyphenol oxidase and the amount of polyphenol at the cortex of the tubers double in quantity in a few days after the irradiation. On the other hand, the activity of amylase, the amount of free amino acids, the total amount of nitrogen, the amount of all sugars and reducing sugar, the gas chromatogram of fragrance ingredient, and the amount of each ingredient are not affected by the irradiation. The number of microbes adhering to the irradiated potatoes is not affected by the irradiation. (Japan)

664 TOXICOLOGICAL STUDIES ON IRRADIATED POTATOES. Ikeda, Y.; Tobe, M. (National Inst. of Hygienic Sciences, Tokyo). Proc. Jap. Conf. Radioisotop.; No. 10, 407-409(Apr 1972). (In Japanese).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

The safety of potatoes irradiated with gamma rays was tested by the long-term breeding and alternation of generations of animals. The potatoes were irradiated with 0; 15; 30; and 60-kR gamma rays. Five male Macaca mulatta separated in two groups were used in the short-period poison test for six months. No evident difference in body weight, feeding, and drinking was observed between two groups. No especial change was seen in both groups, except passing diarrhea which is common in both groups. No difference was detected in urine nitrogen, AIP, GOT, GPT, and total cholesterol between two groups by morphological and biochemical blood tests. There was no difference in the weight of intestines and in pathological histological examination. In the generation test using mice, no remarkable effect of the potatoes irradiated with gamma rays was observed. (Japan)

665 RADIATION INDUCED MUTATIONS IN BRASSICA CAMPESTRIS L. Effect of Gamma Irradiation Upon Plant Height and Branching. Haq, M. I.; Abidi, Z. H. (Coll. of Agriculture, Tandojam, India). Sci. Ind. (Karachi); 9: No. 1-2, 80-83(1972).

Seeds of three varieties of brown mustard, Brassica campestris L., viz., S-2, S-4 and S-9, were irradiated by gamma rays with

five different doses, namely 75, 100, 125, 150 and 175 Kr of ^{60}Co. M_1 generations were grown under field conditions and compared with their respective control. The plant height was reduced due to the effects of radiations, although the character failed to display any regular trend. Branching, which is one of the yield components, was also found to display a general depressive effect of irradiations. The discrepancy in the behavior of different varieties to different radiation treatments may be ascribed to the buffering conditions in the genomes of the crop, created through their polyploid nature and to the polygenic character of plant height and branching. (auth)

666 RADIOBIOLOGICAL INVESTIGATIONS IN CEREALS. 7. Relationship Between Radical Content and Radiosensitivity in *Caryopses of Radiosensitive and Radioresistant Wheat Cultivars.* Walther, F. (Kernforschungsanlage, Juelich, Ger.); Haug, A. Radiat. Bot.; 13: No. 1, 19-25(Feb 1973).

Electron paramagnetic resonance measurements were carried out to correlate the radioinduced free radical concentration with *the genetically determined difference in radiosensitivity of the* two cultivars Bayro and Walthari. Irradiation of dry caryopses (5% water), embryos (2% water), and wet caryopses (12.5% water) *with gamma rays under aerobic conditions and at room temperature*, did not show a statistically significant relationship between free radical content and differences in radiosensitivity in the two cultivars. The radical concentration in various parts of a caryopsis (embryo, endosperm, and coatings) changed during storage in air and at room temperature, independently of the cultivars tested. (auth)

667 ISOLATION OF THE MUTATION PLANTS FROM *SECTORIAL CHIMERA INDUCED BY IRRADIATION IN BEGONIA* AND CHRYSANTHEMUM. Matsubara, H. (Tokyo Metropolitan Isotope Research Center); Shigematsu, K.; Suda, H.; Hashimoto, S. Proc. Jap. Conf. Radioisotop.; No. 10, 374-376(Apr 1972). (In Japanese).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

The possibility of isolating and fixing sectorial chimeras in*duced by irradiation in begonia and chrysanthemum was studied.* Techniques of culture in vitro, cutting, layering, and pruning were examined. The technique of culture in vitro to isolate the sectorial chimera and to propagate the mutation is explained by citing examples. Pruning and propagation techniques to isolate and fix the mutant body from the sectorial chimera are also introduced. By the application of the techniques described above, one mutant body of the begonia and several of the chrysanthemum were ob*tained. The possibility of utilizing radiation effectively in plant* breeding was shown, as the mutation can be isolated directly and fixed without losing the slight sectorial chimera, if the techniques *of irradiation, culture in vitro, pruning, and propagation are used* in combination skillfully. (Japan)

668 SOME PHYSICOCHEMICAL CHANGES IN IRRADIATED BER (ZIZYPHUS JUJUBA) DURING STORAGE AND RIPENING. Ahamd, M.; Sattar, A.; Hussain, A.; Jamil, M.; Farooqi, W. A.; *Hussain, A. M. (Nuclear Inst. for Agriculture and Biology,* Lyallpur, India). Pak. J. Sci. Ind. Res.; 15: No. 3, 163-166(Jun 1972).

Mature, hard green bers of Umran 13 variety were subjected to gamma radiation and doses of 10, 20, 30, 40, and 50 krads were *administered. The irradiated and unirradiated fruits were stored* at room temperature (30° ± 2°C) and changes in physiological and biochemical parameters like weight loss, change of skin color, *total soluble solids, acidity, sugars, ascorbic acid, pectic sub*stances, chlorophyll, and carotenoids were studied. Fruits subjected to doses of 20 to 40 Krads were relatively firmer and greener, *as compared with unirradiated control after 6 days'* storage. There was no significant loss of any nutritive constituents due to irradiation. Organoleptic tests also did not show any detectable adverse effect of taste and flavor in irradiated fruit. (auth)

Radiation Effects on Animals

Refer also to abstracts 362 and 483.

669 RELEVANCE OF EXPERIMENTAL RADIOBIOLOGY *TO RADIOTHERAPY. Alper, T. (Hammersmith Hospital, Lon*don). Brit. Med. Bull.; 29: No. 1, 3-6(Jan 1973).

The relationships between radiobiology and radiotherapy are briefly discussed under the following headings and the techniques of various workers reviewed in outline: (1) The relevance of cell *survival studies to the clinician, with reference to tissue culture* methods and proliferation of tumor cells cultured after irradiation. An illustration is taken from the study of the survival of mice *6 days after irradiation with neutrons, electrons, or x rays* matched with survival curves of jejunal crypt cells. Results in these fields indicate that the determinants of cell survival within a tumor left in situ are different from those that operate when an *irradiated tumor is excised and the cells regrown in a new en*vironment. (2) Hypoxic cells and their sensitization. (3) Estimation of sublethal damage, with particular reference to RBE. (UK)

Man

670 (CONF-720669-, pp 491-509) POSSIBILITIES FOR RADIOBIOLOGICAL AND BIOMEDICAL RESEARCH WITH FAST HEAVY IONS. Todd, P. (Pennsylvania State Univ., University Park). 1972.

In proceedings of heavy-ion summer study.

671 (JPRS-56620) SPACE BIOLOGY AND MEDICINE, *VOL. 7, NO. 1, 1973. Translation of Kosm. Biol. Med.; 7: No. 1,* 3-89(1973). 142p. NTIS.

Articles are presented concerning the selection and training of cosmonauts; evaluation and analysis of accumulated data to facilitate the on-going transition from orbital to interplanetary *flights; research aimed at guaranteeing safety on long flights* and reliability of the human component of the man-spaceship system; space psychology and physiology; environmental problems and *control (spacecraft habitability, effects of radiation and weight*lessness, etc.) and telemetry. (JPRS)

672 (ORNL-NSIC-53) RADIOGRAPHY INCIDENTS AND OVEREXPOSURES. Scott, R. L.; Gallaher, R. B. (Oak Ridge National Lab., Tenn.). Dec 1972. Contract W-7405-eng-26. *84p. Dep. NTIS $10.00.*

Radiography is a process of visualizing the interior of objects opaque to light by using penetrating radiation such as x rays or gamma rays. This report contains 302 abstracts of documents related to various aspects of radiographic operations covering *the period from June 1963 through December 1971. The docu*ments include personnel exposures as well as incidents resulting from personnel errors, management errors, and mechani*cal failures. A brief review of the documents was made and the* information compiled to provide some insight into possible methods of reducing the personnel exposures as well as the operator and *management errors in radiographic operations. (auth)*

673 BENEFITS AND RISKS IN NUCLEAR MEDICINE. *Johnson, P. C. (Baylor Univ., Waco, TX). Amer. J. Pub. Health;* 62: No. 10, 1568-1572(Oct 1972).

Evidence is available that shows that: The patient's risk from radiation exposure during and following nuclear medicine procedures is no greater than the risk from other diagnostic or treatment procedures used commonly in modern hospitals. Employing a nuclear medicine procedure may avoid the need of performing diagnostic procedures that have a more significant risk of mor*tality and morbidity associated with their use. Nuclear medicine* procedures represent a small but increasing portion of a patient's radiation exposure during hospitalization. At the present and in the *near future there would seem to be no valid reason for withholding* nuclear medicine procedures from the diagnostic armamentarium available to the practicing physician and to his patient. (auth)

674 NATIONAL NETWORK OF PHYSICIANS INVESTIGATES CLAIMS OF RADIATION INJURY IN THE NON-OCCUPATIONALLY *EXPOSED POPULATION. Holder, L. E. (Cincinnati General* Hospital). Amer. J. Pub. Health; 62: No. 10, 1387-1390(Oct 1972).

A nationwide volunteer group of physicians, coordinated through the Environmental Protection Agency's Western Environmental Research Laboratory, is available to investigate claims of radiation *injury purported to be the result of Atomic Energy Commission* nuclear testing activities. The history and investigative procedures of this Medical Liaison Officer Network are discussed. The case *investigation experiences are characterized demographically,* medically, and psychologically. The fact that none of the claims could be causally related to radiation does not mitigate the value *of the organization. (auth)*

675 CHONDROSARCOMA ARISING IN A CARTILAGINOUS *AREA OF PREVIOUSLY IRRADIATED FIBROUS DYSPLASIA.* Feintuch, T. A. (Baroness Erlanger Hospital, Chattanooga). Cancer; 31: No. 4, 877-881(Apr 1973).

A 40-year-old woman developed a chondrosarcoma in an area of fibrous dysplasia. There was extensive cartilage formation associated with her primary disease and a history of radiation therapy to the area 30 years before. Chondrosarcoma arising in fibrous dysplasia characterized by extensive cartilage formation has never *been reported. The proliferating cartilage in this form of fibrous* dysplasia may be similar to Ollier's disease in which chondrosarcoma is frequent. Because of this association, the effect of the *patient's prior irradiation is unclear. Patients with fibrous*

dysplasia manifested by large quantities of cartilage should be considered at risk for the development of chondrosarcoma. (auth)

676 ANAEROBIC LIVER ABSCESS COMPLICATING RADIATION ENTERITIS. McLaughlin, P.; Meban, S.; Thomas, W. G. (Univ. of Ottawa). Can. Med. Ass. J.; 108: No. 3, 353-354(3 Feb 1973).

Multifocal liver abscess developed in a 68-year-old woman with radiation enteritis. Two strains of Bacteroides fragilis were cultured from the liver and blood. Surgical drainage was not possible, and in spite of appropriate antibiotic therapy the patient died. Pyrogenic liver abscess is an uncommon condition with an incidence in most series between 0.003 and 0.008 cases per 100 hospital admissions. To the knowledge of the authors this is the first reported case of liver abscess complicating radiation enteritis. (CA)

677 RADIATION PROTECTION. A Guide for Scientists and Physicians. Shapiro, J. Cambridge, MA; Harvard University Press (1972). 354p.

This manual was written for individuals who wish to become qualified in radiation protection as an adjunct to working with sources of ionizing radiation or using radionuclides in the field of medicine. It provides the radiation user with information needed to protect himself and others and to understand and comply with governmental and institutional regulations regarding the use of radionuclides and radiation sources. It is designed for a wide spectrum of users, including physicans, research scientists, engineers, and technicians. The presentation is designed to obviate the need for reviews of atomic and radiation physics, and the mathematics has been limited to elementary arithmetical and algebraic operations. (200 references) (CH)

678 ESTIMATION OF POPULATION DOSE FROM MEDICAL RADIATION IN JAPAN. Hashizume, Tadashi (National Inst. of Radiological Sciences, Chiba, Japan). Proc. Jap. Conf. Radioisotop.; No. 10, 219-221(Apr 1972). (In Japanese).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

Population dose from medical, i.e., diagnostic and therapeutic, radiations in Japan was studied from about 1956 to 1971. First, in 1956, the dosage to genital organs by x-ray radiography was estimated as 11.9 mrad/person/year. Then, in 1960, the genetically significant dose by x-ray radiography as obtained by survey-and-phantom technique and UN's formula was 36.6 mrad/person/year. Then, from 1962 to 1964, the marrow-absorbed dose due to x-ray diagnosis measured similarly was 79 mrad/person/year. In 1969, the genetically significant dose due to the x-ray diagnosis was 26.5 mrad/person/year; and the leukemia significant dose was 169 mrad/person/year. Finally, in 1971, the genetically significant, marrow and leukemia significant doses due to radiation therapy were 0.74, 210, and 36.6 mrad/person/year, respectively. (Japan)

679 LOSS AND RECOVERY OF TASTE ACUITY IN PATIENTS IRRADIATED TO THE ORAL CAVITY. Conger, A. D. (Temple Univ., Philadelphia). Radiat. Res.; 53: No. 2, 338-347 (Feb 1973).

Quantitative tests of taste threshold to sucrose, hydrochloric acid, and quinine were made before, during, and after radiation in therapy patients irradiated to the oropharynx. Loss of taste acuity is smoothly exponential and rapid (240 rads halves bitter acuity, 400 rads acid) out to an accumulated dose of about 3000 rads. Rate of loss then slows down as the patients' acuity approaches nil at ≥3000 rads; taste threshold has increased 500 to 8000 times, probably more. At this state, ≥3000 rads, patients can just barely detect as sweet a sucrose solution equivalent to about 25 teaspoonfuls of sugar per teacup, as acid a solution one-half as concentrated as full strength household vinegar, or as bitter a quinine solution 1500 times as concentrated as in the bottled carbonated Quinine Water. The particular taste sensitivity mostly lost (sweet, acid, or bitter) is correlated with the area of the mouth in the primary radiation field. A tenfold recovery in taste acuity, which is recognizable by the patient, is achieved within 20 to 60 days after radiation ends, and full recovery to normal or preirradiation acuity is attained within 60 to 120 days. The mechanism for a large share of the taste acuity loss is believed to be radioinduced damage to the microvilli of the taste cells, or to their surfaces. (auth)

680 EFFECTS OF RADIATION DOSE-RATE. From Protected, Continuous Irradiation to Ultra-High Dose-Rates from Pulsed Accelerators. Berry, R. J. (Churchill Hospital, Oxford). Brit. Med. Bull.; 29: No. 1, 44-47(Jan 1973).

An outline review of the literature is made under the following headings: (1) the importance of dose-rate for x radiation and γ radiation used in radiotherapy; (2) protracted irradiation, (a) the relative importance of dose-rate and total exposure time and (b) the effect of dose-rate on irradiation under hypoxic conditions; (3) variations of biological effects using conventional dose-rates; (4) biological effects of ultra-high dose-rates, including the radiochemical utilization of oxygen; (5) effects of dose-rate on the biological response to radiations such as fast and fission neutrons. (UK)

681 ENVIRONMENTAL HEALTH. Purdom, P. W. (ed.). New York; Academic Press, Inc. (1971). 595p. $20.50.

A separate abstract was prepared on one chapter. Eleven additional chapters discuss the relation of the environment to public health, disease vectors, food supplies, the management of water and liquid wastes, air pollution, the management of solid wastes, control of the environment, housing, accident prevention, and environmental management. (CH)

For an abstract of an individual paper see: 682.

682 IONIZING RADIATION. Rogers, J. C. (County of Los Angeles Health Dept., Los Angeles). pp 351-377 of Environmental Health. Purdom, P. W. (ed.). New York; Academic Press, Inc. (1971).

The sources of ionizing radiation to which man may be exposed, the biological effects of radiation, and radiation protection methods and practices are reviewed. Topics discussed include: radiation-producing machines; nuclear reactions; fallout; the half-life concept of radioactive material; radiation detection instruments and monitors; the genetic and somatic effects of radiation; units used in radiation measurements; radiation protection as a function of distance, shielding, and time; and radiation protection laws, regulations, and recommendations of the Federal and State governments and of the AEC to insure the protection of the general population against hazardous exposure to ionizing radiations. (CH)

683 PROCEEDINGS OF THE SIXTH BERKELEY SYMPOSIUM ON MATHEMATICAL STATISTICS AND PROBABILITY HELD AT THE UNIVERSITY OF CALIFORNIA, BERKELEY, APRIL 9-12, 1971, JUNE 16-21, 1971, AND JULY 19-22, 1971. Volume VI. Effects of Pollution on Health. Le Cam, L. M.; Neyman, J.; Scott, E. L. (eds.). Berkeley and Los Angeles, CA; Univ. of California Press (1972). 615p. (CONF-710716-).

From sixth symposium on mathematical statistics and probability; Berkeley, California, USA (19 Jul 1971).

Separate abstracts were prepared for nine papers presented at the conference. An additional 23 papers were presented on various aspects of effects of pollution on health. (HLW)

For abstracts of individual papers see: 684-691 and 727.

684 RESEARCH PROGRAMS OF THE ATOMIC ENERGY COMMISSION'S DIVISION OF BIOLOGY AND MEDICINE RELEVANT TO PROBLEMS OF HEALTH AND POLLUTION. Totter, J. R. (Atomic Energy Commission, Washington, DC). pp 71-100 of Proceedings of the Sixth Berkeley Symposium on Mathematical Statistics and Probability. Volume VI. Le Cam, L. M.; Neyman, J.; Scott, E. L. (eds.). Berkeley and Los Angeles, CA; Univ. of California Press (1972).

From sixth symposium on mathematical statistics and probability; Berkeley, California, USA (19 Jul 1971). See CONF-710716-.

The major long-term objective of measuring and evaluating the effects of radiations on man is emphasized. A review is presented of studies on genetic effects; the following topics are discussed: early and late somatic effects of external radiation; effects of total dose and dose rate; and quality of radiation and its interrelationship to dose and dose rate. Studies on human exposures are reviewed with regard to radium and thorium recipients, accidental exposures, and therapeutic exposures. Studies on mice and beagles are reviewed in relation to the internal emitter program and the inhalation carcinogenesis program is discussed. A review of studies on movement of radioisotopes in the environment is presented and a diagram to show ^{137}Cs cycling in a tulip poplar forest is presented. (HLW)

685 ENVIRONMENTAL RADIATION AND HUMAN HEALTH. Sternglass, E. J. (Univ. of Pittsburgh). pp 145-221 of Proceedings of the Sixth Berkeley Symposium on Mathematical Statistics and Probability. Volume VI. Le Cam, L. M.; Neyman, J.; Scott, E. L. (eds.). Berkeley and Los Angeles, CA; Univ. of California Press (1972).

From sixth symposium on mathematical statistics and probability; Berkeley, California, USA (19 Jul 1971). See CONF-710716-.

A brief history of studies on the effects of low-level radiation on human health is presented. The following topics are discussed: fallout and childhood leukemia; early indications relating fallout and infant mortality; fallout and congenital malformations; infant

mortality and releases from nuclear reactors; infant mortality near boiling water reactors; infant mortality and nuclear fuel processing facilities; infant mortality near a gas-cooled reactor; nuclear air pollution and respiratory disease mortality; infant mortality changes near a pressurized-water reactor; effects of low-level fallout from nuclear testing in Long Island, New York; leukemia in Nassau County, Long Island, associated with fallout; infant mortality near Brookhaven National Laboratory, Long Island, New York; and infant mortality and underground tests. (HLW)

686 STATISTICAL STUDIES OF THE EFFECT OF LOW LEVEL RADIATION FROM NUCLEAR REACTORS ON HUMAN HEALTH. DeGroot, M. H. (Carnegie-Mellon Univ., Pittsburgh). pp 223-234 of Proceedings of the Sixth Berkeley Symposium on Mathematical Statistics and Probability. Volume VI. Le Cam, L. M.; Neyman, J.; Scott, E. L. (eds.). Berkeley and Los Angeles, CA; Univ. of California Press (1972).

From sixth symposium on mathematical statistics and probability; Berkeley, California, USA (19 Jul 1971). See CONF-710716-.

The purpose of the study was to relate health indices such as the annual infant mortality, fetal mortality, prematurity, and fertility rates for a given population to measures of the annual amounts and compositions of radioactive gaseous and liquid discharges from a given nuclear reactor. Preliminary multiple regression analyses were carried out for the Dresden reactor in Grundy County, Illinois, the Shippingport reactor in Beaver County, Pennsylvania, the Indian Point reactor in Westchester County, New York, and an experimental reactor at Brookhaven National Laboratory in Suffolk County, New York. In these regression models, the infant mortality rate in a given county containing a nuclear reactor, or the logarithm of this rate, was regressed on the amounts of radioactive gaseous and liquid wastes from the reactor and on either the infant mortality rate in a specified reference population or on a general linear trend in time. Results were inconclusive. (HLW)

687 EPIDEMIOLOGIC STUDIES OF CARCINOGENESIS BY IONIZING RADIATION. Gofman, J. W.; Tamplin, A. R. (Univ. of California, Berkeley). pp 235-277 of Proceedings of the Sixth Berkeley Symposium on Mathematical Statistics and Probability. Volume VI. Le Cam, L. M.; Neyman, J.; Scott, E. L. (eds.). Berkeley and Los Angeles, CA; Univ. of California Press (1972).

From sixth symposium on mathematical statistics and probability; Berkeley, California, USA (19 Jul 1971). See CONF-710716-.

It is pointed out that a study of human epidemiologic data is not a desirable approach to the study of pollutant effects; a more appropriate approach is the study of dose-response relationships. The following topics are reviewed: carcinogenesis and leukemogenesis in humans exposed to ionizing radiation; dose-response relationships in radioinduced cancer and leukemia; time of onset of carcinogenic response and its duration; variation in carcinogenic dose response relationship with age; carcinogenic consequences of population exposure to environmental ionizing radiation; life shortening by radioinduced cancer; and mitigating factors that could reduce the estimated hazard of population exposure. (HLW)

688 INFANT MORTALITY AROUND THREE NUCLEAR POWER REACTORS. Tompkins, E. A.; Hamilton, P. M.; Hoffman, D. A. pp 279-290 of Proceedings of the Sixth Berkeley Symposium on Mathematical Statistics and Probability. Volume VI. Le Cam, L. M.; Neyman, J.; Scott, E. L. (eds.). Berkeley and Los Angeles, CA; Univ. of California Press (1972).

From sixth symposium on mathematical statistics and probability; Berkeley, California, USA (19 Jul 1971). See CONF-710716-.

Three nuclear power facilities were selected for study: the Humboldt Bay Plant Unit 3 at Eureka, California; the Dresden Nuclear Power Station Unit 1 at Morris, Illinois; and the Big Rock Point Power Station at Charlevoix, Michigan. Four concentric geographical bands were defined around each reactor site, the largest from 100 to 200 miles, and the appropriate population of live births and infant deaths within each band was estimated for each reactor. The data were tabulated and it was concluded that patterns of infant mortality around boiling water power plants do not support a hypothesis of an increase in infant mortality associated with the reactors. It is pointed out that malignancies that have been associated with exposure to radiation have long latent periods and that background radiation is highly variable. (HLW)

689 POPULATION EXPOSURE TO RADIATION: NATURAL AND MAN-MADE. Sailor, V. L. (Brookhaven National Lab., Upton, NY). pp 291-311 of Proceedings of the Sixth Berkeley Symposium on Mathematical Statistics and Probability. Volume VI. Le Cam, L. M.; Neyman, J.; Scott, E. L. (eds.). Berkeley and Los Angeles, CA; Univ. of California Press (1972).

From sixth symposium on mathematical statistics and probability; Berkeley, California, USA (19 Jul 1971). See CONF-710716-.

A review of the literature on environmental radiation is presented with emphasis on difficulties in evaluating health hazards associated with radiation. Population dose distributions from natural radiation are reviewed with regard to sources of radiation, geographical and temporal variations, and the effect of shelter. A review of exposures to man-made radiation is presented with regard to medical x rays, fallout from weapons testing, and commercial nuclear power. Special biological hazards of radioactive iodine, strontium, and tritium are discussed. (HLW)

690 RADIATION AND RISK: THE SOURCE DATA. Patterson, H. W.; Thomas, R. H. (Univ. of California, Berkeley). pp 313-344 of Proceedings of the Sixth Berkeley Symposium on Mathematical Statistics and Probability. Volume VI. Le Cam, L. M.; Neyman, J.; Scott, E. L. (eds.). Berkeley and Los Angeles, CA; Univ. of California Press (1972).

From sixth symposium on mathematical statistics and probability; Berkeley, California, USA (19 Jul 1971). See CONF-710716-.

A review is presented of sources of studies on radioinduced injury following rather large acute exposures. The natural radiation of the environment is discussed and it is shown that the extreme variations in whole-body exposures vary from about 100 mrem/yr to an upper limit of a few rem/yr. A discussion is presented of the size of population needed for an epidemiological study of radioinduced disease. Radiation and risk studies are reviewed with regard to the following: Hiroshima and Nagasaki victims, ankylosing spondylitis patients, radium dial painters, incidence of lung cancer in uranium miners, and incidence of leukemia in U. S. radiologists. Natural background radiation is discussed with regard to terrestrial radioactivity, natural radioactivity in the diet, and cosmic rays. Concerning man-made sources of radiation it is pointed out that nuclear reactors are unimportant in terms of the radiation exposure they deliver to the population, but that medical x rays are by far the greatest contributor to population exposure. (HLW)

691 RADIATION AND INFANT MORTALITY: SOME HAZARDS OF METHODOLOGY. Landau, E. (Environmental Protection Agency, Washington, DC). pp 345-353 of Proceedings of the Sixth Berkeley Symposium on Mathematical Statistics and Probability. Volume VI. Le Cam, L. M.; Neyman, J.; Scott, E. L. (eds.). Berkeley and Los Angeles, CA; Univ. of California Press (1972).

From sixth symposium on mathematical statistics and probability; Berkeley, California, USA (19 Jul 1971). See CONF-710716-.

A review is presented of relationships between infant mortality and environmental radiation. Some topics discussed are: assessment of hazards of very low levels of ionizing radiation in the United States by means of published vital statistics; relationship between mortality and the presence of uranium ore reserves; effects of nuclear testing on incidence of leukemia; role of demographic characteristics in infant mortality analysis; and role of radioinduced mutations, radiation injury to the fetus, and hypoxic-induced depression of fetal growth in infant mortality. (HLW)

Vertebrates

Refer also to abstracts 610 and 636.

692 (COO-3332-1) CARBOHYDRATE METABOLISM OF OCULAR TISSUES. Final Report. Kinoshita, J. H. (Massachusetts Eye and Ear Infirmary, Boston). 30 Jun 1972. Contract AT(11-1)-3332. 7p. Dep. NTIS $3.00.

Cataracts produced by radiation and sugar cataracts associated with diabetes and galactosemia were used as models. In both types the crucial phase of cataract development involves changes in the permeability of the lens to cations. In sugar cataracts the lens permeability is compromised by the osmotic effects produced by the accumulation of polyols. In radiation cataracts the ionizing radiation affects the membrane directly leading to permeability changes. It appears that the lens membranes are affected in these two, and many other types of cataracts, during cataract development. The effects of glutathione and sulfhydryl groups on cation transport and on the lens membrane were studied. The effect of calcium on aggregation of proteins was also studied and studies were continued on mechanisms involved in sugar cataracts. (HLW)

693 (FRNC-TH-317) WHOLE-BODY IRRADIATION AND SLEEP IN RAT. Riotte, M. (Lyon Univ. (France)). 1972. 331p. (In French). Dep. NTIS (U. S. Sales Only) $18.75.

Thesis.

It was shown that a whole-body exposure of 800 rads is necessary to induce modifications in the behavior of the animals, the continuously recorded electroencephalograms, and the metabolism of the cerebral amines. Partial irradiations of the same dose level do not have these effects. A whole-body exposure of 800 rads leads to the conservation of slow sleep, a reduced paradoxal sleep, and an increased wakefulness. These perturbations are not due to new factors in the serum of the animals irradiated. In contrast there appears to be a recovery factor in normal serum tending to normalize the disturbed rhythms and in particular the paradoxal sleep. (France)

694 (UR-3490-198) SEQUENTIAL PATHOPHYSIOLOGY OF IONIZING RADIATION ON THE BEAGLE THYROID GLAND. Lu, S.-T. (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). 1972. 81p. Dep. NTIS $6.25.

Thesis.

Response of the thyroid gland to external x irradiation or internal ^{131}I ionizing radiation exposure may manifest itself in a temporal manner, functionally, by transient increased activity and progressive hypothyroidism and pathologically, by degeneration, hyperplasia, and carcinogenesis. Although such derangements have been characterized in animals and man, the pathogenesis and mechanism of the reaction have not been elucidated. Using the dog as an experimental model, evidence was obtained, which indicates vascular alteration may initiate and amplify the visible and functional thyroid derangement. Increase in circulating TSH appears to be secondary to the glandular damage. TSH also appears to be the promoting factor not only in progressive changes and its self-perpetuation but also in the sequence of events leading to permanent hyperplasia or carcinogenesis. The post-irradiation latency for induction of thyroid neoplasia in the dog (4 to 10 years), man (9 to 14 years), and the rat (1 to 2 years) shows a linear relationship with basal metabolic rate. Although this relationship may be fortuitous, it may be indicative of a fundamental factor related to tissue metabolism and thyroid cell turnover rate. (auth)

695 EFFECT OF IRRADIATION ON THE IMMUNE RESPONSE TO THE PRIVATE H-2 SPECIFICITIES OF THE H-2K AND H-2D LOCI. McKenzie, I. F. C. (Massachusetts General Hospital, Boston). J. Immunol.; 110: No. 4, 1154-1156(Apr 1973).

The immunosuppressive effects of irradiation on the immune response to H-2K and H-2D region specificities were studied. Donor skin was grafted to irradiated recipient mice, both donor and F_1 hybrid recipients being selected so that only a single private H-2 specificity was examined. The recipient received 400 rads of irradiation on the day before receiving a skin graft. A table is presented to show the effect of irradiation on rejection of skin grafts with single private H-2D or H-2K specificities as the only antigenic difference. It was found that the degree of suppression was greater for the H-2D specificities than for the more immunogenic H-2K specificities. A marked degree of prolongation of skin graft survival could be produced by irradiation of the recipient provided that the only foreign antigen present on the graft was a single private H-2D specificity. (HLW)

696 TRANSFER OF DNP–BSA HYPERSENSITIVITY IN GUINEA PIGS BY MEANS OF IRRADIATED DONOR PLASMA. Evidence That the Cutaneous Reactivity is Hapten-Specific and Mediated via DNP Antibody. Richardson, W. P.; Paterson, P. Y. (Northwestern Univ., Chicago). J. Immunol.; 110: No. 4, 905-910 (Apr 1973).

Cutaneous sensitivity to 2,4-dinitrophenylated bovine serum albumin was transferred with plasma from sensitized, irradiated guinea pigs following the procedure of Dupuy and Good. Enhanced cutaneous reactivity was observed in recipients of plasma from irradiated (800 rads) donors as compared to plasma from nonirradiated donors. Cutaneous reactions of plasma recipients were greater at 3 to 4 hr than at 24 hr after skin testing and they exhibited clear-cut hapten, as opposed to carrier, specificity. The plasma used to transfer this sensitivity contained precipitating antibody, which also was hapten-specific. These data demonstrate that the transferred sensitivity was immediate and due to circulating, precipitating DNP antibody producing a toxic antigen–antibody complex reaction of the Arthus type. (auth)

697 PERMEABILITY OF ARTERIAL INTERNAL ELASTIC LAMINAE IN IRRADIATED MICE. Hampton, J. C.; Rosario, B. (Battelle Pacific Northwest Labs., Richland, WA). Contract AT(45-1)-1830. Exp. Mol. Pathol.; 17: No. 3, 307-316(Dec 1972).

Mice were exposed to 1500 R x-irradiation and then injected with horseradish peroxidase (HRP) about 2 min prior to sacrifice on days 1, 2, 3, 3.5 and 4 post-exposure. Arteries from various tissues were examined for localization of HRP reaction product. Some arteries showed little or no localization whereas others showed moderate to intense localization in the internal elastic lamina and elastic tissue in the adventitia, suggesting early damage to dense elastic tissue. (auth)

698 EFFECT OF FRACTIONATION ON TUMOR INDUCTION AND HAIR FOLLICLE DAMAGE IN RAT SKIN. Burns, F. J.; Albert, R. E.; Sinclair, I. P.; Bennett, P. (New York Univ., NY). Contract AT(11-1)-3380. Radiat. Res.; 53: No. 2, 235-240(Feb 1973).

Recovery with respect to tumor and atrophic follicle induction was measured in terms of the difference ($D_2 - D_1$) between the fractionated dose (D_2) and the single dose (D_1) for equal effects. An initial dose of 750 rads was given to the dorsal skin of male, albino rats when the hair follicles were in the resting phase. Thirty-one days later, again in the resting phase, groups of previously irradiated rats and comparable unirradiated rats were given the following doses: 0 rads, 750 rads, 1500 rads, 2250 rads, and 3000 rads. The rats were observed every 4 weeks for 80 weeks. At 80 weeks all skin lesions were examined histologically, and the incidence of atrophic hair follicles was determined by observation of epithelial mounts. The values of $D_2 - D_1$ for skin tumor induction and hair follicle atrophy were 650 rads and 600 rads, respectively. (auth)

699 ABSCOPAL DELAY OF EMBRYONIC DEVELOPMENT AFTER PREFERTILIZATION X IRRADIATION. Hahn, E. W.; Feingold, S. M. (Sloan-Kettering Inst. for Cancer Research, New York). Radiat. Res.; 53: No. 2, 267-272(Feb 1973).

In order to assess possible maternal effects of prefertilization x-irradiation on the development of embryos, Long–Evans rats in metestrus were exposed to 0, 200, or 400 R with concomitant shielding of the right lower-body quadrant. When the rat was irradiated 3 to 4 days prior to mating with 200 or 400 R with the right lower-body quadrant shielded to include the right ovary, oviduct, and uterine horn, there was a dose-dependent decrease in ovulations from the irradiated ovary and a compensatory increase from the shielded ovary. The total number of ovulations from both ovaries was the same as unirradiated controls. The percentage of ova fertilized on the shielded side was the same as that for controls. However, embryos from the shielded side had an increased blastomere degeneration at 200 and 400 R, and a delayed development at 400 R. This would indicate that the blastomere degeneration and delay in cell division in $3\frac{1}{2}$-day embryos was mediated by maternal irradiation damage. However, the average number of $3\frac{1}{2}$-day embryos was not different from the average litter size of similarly irradiated females allowed to go to term. This indicates that the degeneration and division delay mediated by maternal damage did not affect subsequent development. (auth)

700 PROTON IRRADIATION OF BEAGLE EYES. II. Clinical and Histopathologic Observations for 35 MeV Protons. Horn, P. L.; Shifrine, M. (Univ. of California, Davis). Contract AT(04-3)-472. Radiat. Res.; 53: No. 2, 255-266(Feb 1973).

The eyes of 100-day-old beagles were exposed to 35-MeV protons at surface doses of 70, 125, 240, and 480 rad. Dose-dependent responses in the adnexa were observed 5 days after irradiation and in the crystalline lens, with a slitlamp biomicroscope, beginning at 30 days and appearing most marked 50 to 130 days post exposure. A grading system was established to quantitate the degree of lens involvement. An apparent threshold dose for vision-impairing lens opacifications occurring within 6 months of exposure was found to be between 70 to 125 rad surface dose. Large vacuoles and plaques, aberrant lens fiber cells, and subcapsular epithelial hyperplasia and metaplasia were the most profound histologic changes, occurring in the crystalline lenses of eyes receiving surface doses of 240 and 480 rad. Similar but less severe lens pathology was seen at a surface dose of 125 rad. Eyes receiving 480 rad also had corneal keratinization and vascularization, iridic atrophy, depigmentation, and entropion uveae. Detailed clinical and histopathologic observations are reported. (auth)

701 RADIOPROTECTIVE CAPACITY OF SPLEEN CELLS TRANSPLANTED FROM MICE WITH RAUSCHER VIRAL LEUKEMIA. Okunewick, J. P.; Erhard, P. (Allegheny General Hospital, Pittsburgh). AT(11-1)-3097. Radiat. Res.; 53: No. 2, 241-247(Feb 1973).

Rauscher leukemia virus infection induces a radioresistance in SJL/J mouse, which is accompanied by increases in spleen cells and spleen CFUs of up to 17 times the normal. Experiments were carried out to directly evaluate the radioprotective ability of these spleen cells in relation to normal spleen cells. For this purpose spleen cells from both normal and leukemic mice were transplanted into lethally irradiated normal recipients. The results show that for the first 24 days after irradiation and cell transplant

the radioprotective ability of the RLV-infected cells is at least equivalent to the normal. However after this time the survival curve of the recipients of RLV infected cells is adversely modified by the leukemia. Nevertheless, the number of survivors at 30 days is significantly large enough to conclude that the spleen cells of mice with Rauscher leukemia do protect against radiation-caused mortality. (auth)

702 EFFECT OF RADIATION ON THE NUCLEAR PROTEIN BIOSYNTHESIS IN THE LIVER AND SPLEEN OF THE WHITE RAT. Paskevich, I. F.; Likhoded, V. S.; Stolyarov, I. V.; Fonarev, A. B. (Kharkov Scientific Research Inst. of Medical Radiology). Dokl. Akad. Nauk SSSR; 208: No. 3, 739-741(21 Jan 1973). (In Russian).

The biosynthesis of nuclear proteins in rat spleen and liver was studied for the purpose of elucidating post-irradiation changes and disturbances in the regulating system for the transcription processes. Male white rats were given 400 and 600 R doses of x radiation, and then the organs were examined 24, 48, and 120 hr later. The incorporation into the protein of ^{14}C and $Na_2H^{32}PO_4$ aided the biosynthesis studies. Radiation doses in the amount of 600 R increased the incorporation of the labeled atoms in the protein fractions studied; the pattern for 400 R was the same but less pronounced. (KSW)

703 EFFECT OF MULTIPLE TOTAL IRRADIATION ON HEALING BONE FRACTURES. Omarov, M. A. Med. Radiol.; 18: No. 2, 64-66(Feb 1972). (In Russian).

The influence on bone healing of total external irradiation in relatively small doses was investigated. Consolidation of the second metatarsal bones in the right paws of 32 male rabbits was observed 14, 28, 42, and 56 days after fracture. Daily 20 R doses of x rays were administered during this period. Radiograms, histological and histochemical data showed that in the initial stages of the experiment, callosities appeared more frequently in the irradiated animals than in the controls. (KSW)

704 IRRADIATION OF INTRACRANIAL STRUCTURES IN SMALL ANIMALS BY A NARROW BEAM OF HIGH-ENERGY PROTONS. Minakova, E. I.; Kleinbok, Ya. L.; Lomanov, M. F.; Pavlonskii, L. M.; Khoroshkov, V. S.; Vinogradov, V. N. (Inst. of Experimental and Clinical Oncology, Erevan). Med. Radiol.; 18: No. 2, 29-36(Feb 1972). (In Russian).

The technique of static irradiation by a narrow beam of protons allowing spot (with an accuracy of 0.1 to 0.3 mm) local radiation injury of tissues of different area and required depth to be made is described. Irradiation of the target can be made both once and repeatedly from one or two symmetrical fields through or with retention of protons in the tissues. The technique is morphologically verified experimentally by local irradiation with a narrow beam of protons (3 to 5 mm in diameter) at 200 MeV of the hypophysis, chiasm, olfactory bulbs, hypothalamic formations, etc. in 150 animals (albino rats). When irradiating with doses of 10 to 30 krad local injuries with distinct borders were obtained, this corresponding to the gradient of dose distribution in the cross-section of the beams. This technique can be used in various radiobiological investigations, as well as in bloodless pathophysiological experiments with destruction of intracranial or extracranial targets in small animals. (auth)

705 INFLUENCE OF β-MERCAPTOETHYLAMINE ON ^{14}C-VALINE INCORPORATION IN THE PROTEIN-SYNTHESIZING SYSTEM OF SPLENIC NUCLEI IN RATS. Nikol'skii, A. V.; Blokhina, V. D.; Romantsev, E. F. Tsitol. Genet.; 5: No. 2, 476-478(1971). (In Russian).

Experiments conducted on rats demonstrated β-mercaptoethylamine capable of inhibiting protein synthesis in the DNP system. This effect is of great significance in the mechanism of radioprotective action of the agent under discussion. (auth)

706 EFFECT OF IONIZING RADIATIONS ON NUCLEAR DEOXYRIBONUCLEIC ACID IN THE HEPATIC CELLS IN THE COURSE OF REGENERATION. Parteni, L.; Schiau, S.; Butculescu, I.; Ciontescu, L.; Stoenescu, R. Rev. Roum. Physiol.; 10: No. 1, 53-65(1973). (In French).

The liver during regeneration was used as an experimental model for its synchronism of mitosis and the synthesis of DNA. In the course of sensitive phases (G_1 and S) of the synthesis of DNA animals were irradiated by x rays. The experimental animals, adult Wistar rats, were sacrificed 20 hr after partial hepatectomy. The nuclear DNAs obtained from samples of the liver of the irradated animals in the course of regeneration following various doses (10, 15, 20, 30, 50, 100, and 250 R) were characterized by the N/P ratio, uv absorption, molar absorption (ϵ(P)), and the specific radioactivity of ^{32}P. Results made it possible to establish a linear relation between doses of x rays and their effects. The dose of 30 R always had a maximum effect. Four hours after hepatectomy the DNA showed the greatest radiosensitivity, an increased hyperchromism, and a maximum incorporation of ^{32}P. DNA at 6 hr is radioresistant, presents a hypochromism, and a minimal incorporation of ^{32}P. Study of DNA under the influence of radiations records regeneration by stages presenting periods in which the liver behaves as a tissue at rest. (tr-auth)

707 EFFECT OF MEXAMINE, CYSTAMINE, CYSTAPHOS, AND AET ON THE PERMEABILITY OF THE HISTO-HEMATIC BARRIERS OF THE ADRENAL AND THYROID GLANDS. Savaev, V. V.; Shashkov, V. S.; Sergeev, P. V.; Chistyakov, V. A.; Seidametov, M. A. Farmakol. Toksikol.; 35: No. 3, 336-339(1972). (In Russian).

Tests staged on rats demonstrated that administration of radioprotective compounds causes changes in the functional condition of tissular barriers of endocrine organs manifested in an increased passage of ^{131}I-albumin into the adrenal tissue and in reduced accumulation of the tracer in the thyroid tissues. A relation between the degree and duration of changes in the permeability of histohematic barriers of the thyroid and the cystamine, cystaphos, and AEC dosages was deduced. (auth)

708 EFFECT OF IRRADIATION ON GASTRIC SECRETION IN THE RAT AND THE RADIOPROTECTIVE EFFECT OF ATP. Groza, P.; Gheorghe, N.; Stefan, M. Rev. Roum. Physiol.; 10: No. 1, 3-11(1973). (In French).

By observations on gastric secretion in the rat, studied according to the method of Shay, it was ascertained that irradiation by a single dose of 500 R produced some important changes in acid flow, which consist in an increase in the flow that attains excessive values the first five days. The acid concentration showed tendencies to return to normal near the end of the interval of investigation, which was about 15 days. ATP (30 mg/kg body weight) administered 30 min before irradiation had a radioprotective effect manifested by a decrease in acid flow especially in the phase where it showed excessive values having a potentially seriously damaging effect on the gastric mucosa. The activity of the ATPase of the gastric mucosa showed, both under the simple influence of irradiation and under the protection of ATP, some relations suggesting its intervention in the process of the synthesis of the acid secretion. (tr-auth)

709 PERVICHNYE I NACHAL'NYE PROTSESSY BIOLOGICHESKOGO DEISTVIYA RADIATSII. (Initial Processes of the Biological Action of Radiation). Afanas'ev, G. G. (ed.). Moscow; Izdatel'stvo Nauka (1972). 272p.

An international conference on the initial processes of the action of ionizing radiation in biological systems resulted in these 29 papers. White rats, mice, Escherichia coli, and Saccharomyces sp. were the principal experimental organisms used in irradiation tests. Enzymes were also studied extensively. Both gamma and x-radiation were employed in in vitro and in vivo experiments. The roles of DNA, certain radiotoxins, radiation sensitivity, and oxygen were employed. (KSW)

710 EFFECT OF ROENTGEN IRRADIATION ON THE FORMATION OF ENAMEL AND DENTIN IN MAXILLARY RAT INCISORS. Lindvall, A. M.; Omnell, K. A.; Schildt, B. E. (Univ. of Lund, Sweden). Scand. J. Dent. Res.; 80: 253-263(1972).

An investigation of roentgen-induced enamel and dentin changes in the maxillary incisor in the rat was undertaken to assess the relative radiosensitivity of amelogenesis and dentinogenesis. Seventy Sprague-Dawley rats received whole-body irradiation with exposures between 500 and 950 rad. Five animals served as controls. During the experimental period all the animals were given an injection of oxytetracycline. The animals were killed 5 to 21 d after irradiation. Ground sagittal sections of the incisors were examined microradiographically and with fluorescence microscopy. The irradiation produced elongated external hypoplastic lesions in the enamel and niches in the dentin. The extent of the lesions varied with the radiation dose. The variation in the extent and appearance of the lesions was much greater in the dentin than in the enamel. Even the smallest dose regularly produced changes in the enamel but seldom in the dentin. Amelogenesis thus proved to be more radiosensitive than dentinogenesis. (auth)

Invertebrates

Refer also to abstract 720.

711 (LA-5227-PR, pp 61-74) MAMMALIAN RADIOBIOLOGY SECTION. Mar 1973.

Annual Report of the Biological and Medical Research Group (H-4) of the LASL Health Division, January–December 1972.

The effects of changing dose rates on the survival of mice exposed to ^{60}Co γ radiation at various accumulated doses were studied and it was concluded that changing dose rates were more

biologically damaging than equivalent constant or fixed dose rates. The effects of continuous exposure to γ radiation at a dose rate of 24 rads/day until death on the hematopoietic response of dogs and monkeys (Macaca mulatto) were compared. The effects of exposure to 2400 rads of γ radiation delivered at 100 rad fractions at 56 day intervals on the survival of monkeys and dogs previously exposed to continuous γ radiation with a dose of 600 rads delivered during a 10 day period were studied. The pathological effects of various doses of 250 kVp x radiation on the skin of normal mice and on the growth rate of a malignant tumor transplanted below the skin of mice were studied. The retention time of ^{113}Sn in mice following administration by ingestion or intravenous or intraperitoneal injection was measured by whole-body counting. The biological half-life was computed to be 379 days. The body burden of fallout ^{137}Cs in a New Mexico population sample during 1972 was measured by whole-body counting and results are compared with measurements made periodically since 1956. The average values for all subjects decreased from a peak concentration of 120 pCi/g K in 1964 to a level of about 20 pCi/g K and have remained there with only small variations during the past four years. (CH)

712 RECOVERY OF FERTILITY IN MALE CODLING MOTHS TREATED WITH 38 KRAD OF GAMMA IRRADIATION. Hutt, R. B.; White, L. D. (Agricultural Research Service, Yakima, WA). J. Econ. Entomol.; 66: No. 2, 388-389(Apr 1973).

Males of Laspeyresia pomonella (L.) treated with 38 krad of gamma irradiation were caged individually with 0- to 24-hour-old virgin females each day for 5 days. Irradiated males recovered fertility in response to both time and number of matings. (auth)

713 GAMMA IRRADIATION OF EGGS OF THE PINK BOLLWORM. Bartlett, A. C.; Staten, R. T.; Ridgway, W. O. (Agricultural Research Service, Phoenix, AZ). J. Econ. Entomol.; 66: No. 2, 475-477(Apr 1973).

Treatment of 4-day-old eggs of Pectinophora gossypiella (Saunders) with doses of ^{60}Co gamma irradiation ranging from 0 to 32 krad had no effect on subsequent egg hatch, but development and eclosion of adults from the resulting larvae were reduced significantly at all doses above 4 krad. Also, when adult males developing from the treated eggs were crossed with normal females, 90% fewer progeny were produced compared with the control at all doses. The sterility was generally the result of lack of mating ability: at 2 krad, 67% of the males did not transfer spermatophores; at 4 krad, none of the males transferred spermatophores. (auth)

714 EFFECTS OF γ RADIATION ON THE PUPAE OF THE COTTON LEAF WORM, SPODOPTERA LITTORALIS BOISD. Hosny, M. M. (Ain Shams Univ., Cairo); Elbadry, E. A.; Wakid, A. M.; Sallam, H. A. Z. Angew. Entomol.; 72: No. 2, 205-212 (1972).

Doses of gamma radiation below the sterilizing levels did not affect the adult emergence of both sexes of Spodoptera littoralis for all the pupal ages used. At the sterilizing doses, a reduction in the adult emergence was conspicuous. The females showed 10% malformations when treated as 1-day-old pupae. Longevity of the adults was, apparently, not affected by the sterilizing doses. Adult fecundity was reduced and the reduction increased with increasing the dose applied to pupae of different ages. The effect of radiation on egg production was greater when applied to 1-day-old pupae then to the other pupal ages. Irradiated males did not play a significant role in reducing the rate of egg laying. (GF)

715 UTILIZATION OF IRRADIATED SPERM FROM SUCCESSIVE MATINGS BY THE FEMALE COWPEA WEEVIL. Tilton, E. W.; Brower, J. H. (Agricultural Research Service Savannah). J. Econ. Entomol.; 66: No. 2, 545-546(Apr 1973).

Male cowpea weevils (Callosobruchus maculatus) were treated with 10 krad of gamma radiation from a ^{60}Co source at a dose rate of 2.3 krad/min. Observations were made on the adult progeny from females isolated with irradiated and unirradiated males. Results indicated that there was a lack of full sperm complement in irradiated males. (HLW)

Radionuclide Effects (Internal Source)

Man

Refer also to abstracts 677, 681, 682, 689, and 726.

716 CHROMOSOME ABERRATION DOSIMETRY IN A CASE OF OVER EXPOSURE TO RADIATION. Lloyd, D. C.; Purrott, R. J.; Dolphin, G. W. (National Radiological Protection Board, Harwell, Eng.). Nature (London); 241: No. 5384, 69-70(5 Jan 1973).

Estimation of radiation dose to the body from the yield of dicentric chromosome aberrations in peripheral blood lymphocytes has been developed into a valuable technique in radiological protection practice, and it has been used as a means of resolving disagreements arising from anomalous film badge readings and in cases of possible over-exposure where no dosimeter was worn. Another use is in the accurate estimation of dose for determining the future employment of exposed radiation workers, and also for guiding clinicians in the treatment of radiation injuries. The case is described of a radiation worker who had been working for several years with ^{192}Ir sources and had lesions on both hands. Lymphocyte cultures were made from a blood sample with the following results: dicentrics 49; centric rings 7; acentric rings 10; interstitial deletions 31; terminal deletions 21. Eighteen dicentric chromosomes were also found minus their associated deletions. As about five years elapsed between the first exposure and the chromosome analysis it was necessary to take into account the rate of loss of lymphocytes from the body. The half-life of lymphocytes carrying dicentric aberrations was found to be about 1000 days and assuming the radiation was received uniformly in equal annual doses during the five years, it was predicted that 90 dicentries would have been found in 500 cells if no cell losses had occurred, and this dicentric yield corresponded to an equivalent whole body exposure of 200 rad. (UK)

717 RADIOACTIVE COLLOIDS IN THE TREATMENT OF STAGE I A OVARIAN CANCER. Piver, M. S. (Univ. of North Caroiina, Chapel Hill). Obstet. Gynecol.; 40: No. 1, 42-44(Jul 1972).

In a retrospective analysis of patients receiving intraperitoneal radioactive colloidal chromic phosphate or colloidal gold the value of these substances in Stage I A ovarian cancer was assessed. In addition, complications of isotope therapy were analyzed in all patients receiving radioactive colloids for Stages I, II or III ovarian cancer. Ninety-four percent of those with Stage I A ovarian cancer were alive without evidence of recurrence after surgery plus radioactive colloids. In a small group (Stage I A) treated by surgery alone 22% were alive without evidence of malignancy. Of 74 women who received intraperitoneal radioactive colloids postoperatively only 1 sustained a moderately severe complication. (auth)

718 INTERNAL EXPOSURE THROUGH RADIONUCLIDES OF DIFFERENT RADIOTOXICITY. Rossbander, W. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Isotopenpraxis; 8: No. 7, 241-244(Jul 1972). (In German).

Calculation of the internal radiation burden from incorporated radioisotopes is discussed. In two tables, data are listed for ^{239}Pu, ^{131}I, ^{32}P, and ^{3}H. The tabulations contain such information as critical organs, maximal permissible dose, inhalation and ingestion, effective half-life, and investigation level. (HBG)

719 LUCHEVAYA BOLEZN' OT VNUTRENNEGO OBLUCHENIYA (OCHERKI KLINIKI I TERAPII). (Radiation Sickness from Internal Irradiation (Outline of Clinical Treatment and Therapy)). Safronov, E. I. Leningrad; Izdatel'stvo Meditsina Leningradskoe Otdelenie (1972). 136p.

Experience over a considerable period of time with persons who had contacted radioactive preparations and with patients suffering from radiation sickness as a result of internal irradiation is summarized. The toxicology of radioactive isotopes and general aspects of illness caused by internal irradiation are discussed. The destructive action of particular isotopes: Po, ^{137}Cs, and the bone-seeking ^{239}Pu, ^{226}Ra, ^{228}Th, and ^{90}Sr, and a number of others (^{14}C, ^{3}H, ^{138}La, ^{238}U, ^{40}K, and ^{87}Rb) are individually discussed. Diagnostics of radiation sickness, methods of detecting internal radioactivity, and first aid techniques after locating the latter, are the subjects of the closing chapters. (425 references) (KSW)

Animals

Refer also to abstract 741.

720 (LA-5227-PR) ANNUAL REPORT OF THE BIOLOGICAL AND MEDICAL RESEARCH GROUP (H-4) OF THE LASL HEALTH DIVISION, JANUARY THROUGH DECEMBER 1972. Richmond, C. R.; Voelz, G. L. (comps.). (Los Alamos Scientific Lab., N. Mex.). Mar 1973. Contract W-7405-eng-36. 161p. Dep. NTIS $3.00.

Separate abstracts were prepared on five sections of this report. Two additional sections discuss the preparation of compounds labeled with stable isotopes (^{13}C, ^{15}N, ^{16}O, ^{17}O, and ^{18}O) for use as tracers in biological, chemical, and medical studies, and the care of animals in the laboratory colony. A list is included of some 80 publications released during the period covered. (CH)

For abstracts of individual sections see: 623, 624, 711, 721, and 725.

721 (LA-5227-PR, pp 1-11) HOT PARTICLE PROJECT. Mar 1973.

Annual report of the Biological and Medical Research Group (H-4) of the LASL Health Division, January–December 1972.

Progress is reported in studies of pathological changes and the incidence of carcinogenesis in the lungs of hamsters at various times following the injection of ^{238}Pu- or ^{239}Pu-labeled ceramic microspheres of various activities into the jugular vein to produce lung burdens of 0.14 to 360 nCi and dose rates ranging from 13 to 12,000 rads/yr. The distribution of the spheres in the lungs was measured using a microradiography procedure using ultrasoft x radiation. Preliminary results are reported on the development of a method to measure the α dose as a function of distance from the microsphere using computer calculations of energy absorbed by interactions with tissues along the particle track. Data on lung retention and urinary excretion of ^{238}Pu and ^{239}Pu are included. (CH)

722 (UR-3490-212) FIVE-YEAR INHALATION STUDY WITH NATURAL URANIUM DIOXIDE (UO_2) DUST. II. Postexposure Retention and Biologic Effects in the Monkey, Dog, and Rat. Leach, L. J.; Yulle, C. L.; Hodge, H. C.; Sylvester, G. E.; Wilson, H. B.. (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). [nd]. 51p. Dep. NTIS $4.75.

Recent inhalation studies show that dogs, monkeys, and rats can breathe a natural uranium dioxide (UO_2) aerosol of approximately three μm mass median aerodynamic particle diameter (MMAD), at a mean concentration of five mg U/m^3 (25 × TLV* or 28 × MPCa**), for periods as long as five years with little evidence of serious injury (L. J. Leach, et al., Health Physics 18, 599, 1970). Some of these animals were observed for protracted postexposure periods during which pulmonary neoplasia developed in a high percentage of the dogs examined two to six years after exposure. Pulmonary and tracheobronchial lymph node fibrosis, consistent with radiation effects, apparently dose dependent, and more marked in monkeys than in dogs was also noted. No evidence of uranium toxicity was found in records of body weights, mortality, various hematologic parameters, or the histologic condition of the kidneys. (auth)

723 *EFFECT OF RADIOACTIVE ISOTOPES ON THE BLOOD SYSTEM.* Korolev, G. K. (Scientific-Research Inst. of Medical Radiology, Moscow). Med. Radiol.; 18: No. 2, 67-80 (Feb 1972). (In Russian).

The literature on the effects of radioisotopes on the blood system was reviewed and a summary is presented. The radioisotopes were divided into three groups for the purposes of discussion: those elements achieving fairly uniform distribution in the organism (^{3}H, ^{134,137}Cs, ^{106}Ru, etc.), those affecting hemopoiesis (^{89,90}Sr, ^{140}Ba, ^{226}Ra, etc.), and those possessing combined effects, such as deposition in bone tissue or the liver (lanthanides, actinides, etc.). Reference is made to experiments on rabbits, rats, dogs, and to observations taken on leukocytes, erythrocytes, neutrophiles, reticulocytes, myelocaryocytes, and lymphocytes. The cells that were most sensitive to the action of radioactive isotopes were lymphocytes, hemocytoblasts, erythroblasts, myeloblasts, and promyelocytes. Neutrophiles, erythrocytes, and mature bone marrow cells were less sensitive. (~50 references). (KSW)

Microorganisms

724 EFFECT OF ISOTOPIC LABEL ON BUOYANT DENSITY DETERMINATIONS OF VIRAL DNA IN THE PREPARATIVE ULTRACENTRIFUGE. Cassia, E.; Bachenheimer, S. (Univ., Ferrara, Italy). J. Virol.; 11: No. 4, 610-613(Apr 1973).

The buoyant density of herpes simplex virus DNA may be significantly increased by isotopic labeling, particularly with ^{14}C. The apparent increase in buoyant density may be readily calculated from the specific activity of the DNA and is easily demonstrated by isopycnic centrifugation in both the preparative and analytical centrifuge. (auth)

Nuclide Kinetics and Toxicology

Refer also to abstracts 351 and 381.

Man

Refer also to abstracts 711 and 718–720.

725 (LA-5227-PR, pp 75-80) PHYSICAL RADIOBIOLOGY SECTION. Mar 1973.

Annual report of the Biological and Medical Research Group (H-4) of the LASL Health Division, January–December 1972.

Chest counts are used to monitor the lung burden from ^{241}Am, ^{238}Pu, and ^{239}Pu at least once a year in all personnel who work actively with transuranic elements. Whole-body counts of all accelerator (LAMPF) personnel are made to provide background data for use in evaluating any changes that may occur as a result of occupational exposure. Methods used for computer processing of the data are discussed. (CH)

726 RETENTION OF ^{90}Sr IN HUMAN BONE AT DIFFERENT AGES AND THE RESULTING RADIATION DOSES. Papworth, D. G.; Vennart, J. (Medical Research Council, Harwell, Eng.). Phys. Med. Biol.; 18: No. 2, 169-186(Mar 1973).

Data on the concentration of ^{90}Sr in diet and bone for people in the United Kingdom are analyzed using a model for the retention of ^{90}Sr in the skeleton in which the fraction of dietary ^{90}Sr entering bone, μ_t, and the fractional rate of bone turnover, λ_t year^{-1}, both vary with age, t years. The best fit to the data is given by the following relationships: $\mu_t = a_0 + a_1 t + a_2 t^2 + a_3 t^3$, and $\lambda_t = c + d \exp[-(t-m)^2/2\sigma^2]$ where $a_0 = 0.1341 \pm 0.0034$, $a_1 = -0.0186 \pm 0.0043$, $a_2 = 0.00205 \pm 0.00054$, $a_3 = -0.000068 \pm 0.000017$, $c = 0.106 \pm 0.026$, $d = 0.615 \pm 0.093$, $\mu = 4.87 \pm 0.41$, $\sigma = 3.80 \pm 0.42$. For adults, in whom the concentration of ^{90}Sr is known to be different in different parts of the skeleton, the rate of turnover in compact bone, λ year^{-1}, is four times less than it is in cancellous bone, and the fractions of dietary strontium entering the two types of bone are both equal to 0.5μ. The values of λ and μ which give the best fit to the data are $\mu = 0.0419 \pm 0.0043$, $\lambda = 0.063 \pm 0.010$ year^{-1}. The results may be used to predict future levels of ^{90}Sr in bone from measurements of the radionuclide in diet and also to calculate the radiation doses received by tissues in bone from intakes of ^{89}Sr and ^{90}Sr. It is estimated that the mean dose in red bone marrow to which the U.K. population is committed as a result of ^{90}Sr in diet up to and including the year 1970 is 34 mrad. The corresponding doses to endosteal cells on the surfaces of bone are about 1.4 and up to three times greater for trabecular bone and for cavities within compact bone respectively. (auth)

727 IMPLICATIONS OF ENVIRONMENTAL STRONTIUM-90 ACCUMULATION IN TEETH AND BONE OF CHILDREN. Rosenthal, H. L. pp 465–478 of Proceedings of the Sixth Berkeley Symposium on Mathematical Statistics and Probability. Volume VI. Le Cam, L. M.; Neyman, J.; Scott, E. L. (eds.). Berkeley and Los Angeles, CA; Univ. of California Press (1972).

From sixth symposium on mathematical statistics and probability; Berkeley, California, USA (19 Jul 1971). See CONF-710716–.

A review is presented of studies on ^{90}Sr accumulation in teeth and bone of children as related to dietary consumption of the nuclide. Discussions and graphs are presented for data on the following: average yearly milk levels of ^{90}Sr in St. Louis from 1948 to 1970; ^{90}Sr content of human fetal mandibular bone and of cow's milk vs the first and last half of the yr of birth; accumulation of ^{90}Sr in deciduous teeth of infants and in permanent teeth of adolescents; and regional variation of ^{90}Sr in deciduous incisors. It was concluded that ^{90}Sr accumulation in calcified tissues of children is linearly related to the concentration in the diet. (HLW)

Animals

728 EXPERIMENTAL STUDIES ON ^{137}Cs REMOVAL BY MEANS OF PERITONEAL DIALYSIS. 3. Peritoneal Dialysis with Potassium-Free Fluid. Dziuk, E. Pol. Arch. Med. Wewn.; 49: No. 3, 223-227(Sep 1972). (In Polish).

Intermittent peritoneal dialysis with potassium-free fluid was used for removal of ^{137}Cs from the organism of rabbits. During a dialysis of 105 min duration, 4.94 ± 1.11% of the administered dose of the isotope was removed. During dialysis with potassium-free fluid hypokalemia developed, which could have been the cause of increased urinary excretion of ^{137}Cs (7.43 ± 1.93% of the administered dose). The metabolic properties of potassium and cesium in the organism of man and animals are compared. (auth)

729 METABOLISM OF TRACE ELEMENTS IN DOMESTIC ANIMALS. The Behavior of ^{90}Sr. Danbara, H. (National Inst. of Animal Industry, Chiba, Japan). Proc. Jap. Conf. Radioisotop.; No. 10, 295-297(Apr 1972). (In Japanese).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

Investigations indicated that ^{90}Sr contamination of milk was caused mainly by contamination of feed. The factors related to the ^{90}Sr contamination of milk are as follows: (1) feeding amount of contaminated grass and blended feed, especially the amount of $CaCO_3$ in the blended feed, (2) ^{90}Sr concentration already taken up in the bone of cows. As the ^{90}Sr amount in the bone is sustaining, the contamination of milk is maintained a rather long time after the ^{90}Sr in feed has been removed. The ^{90}Sr and Ca in milk are the sum of those translocated from the feed and those liberated from the bone, and those rates are influenced by the Ca concentration in the

feed. The ^{90}Sr concentration in milk is a tenth of that in the feed, and a fourth of that in the bone of cows. From these results, it seems to be possible to decrease the Sr concentration in milk by adding a large quantity of Ca to the feed. (Japan)

730 *SOME OBSERVATIONS ON THE DECAY OF ^{32}P IN THE* DESERT LOCUST-SCHISTOCERCA GREGARIA (FORSK). Hugue, H.; Khalique, M. A. (Dept. of Plant Protection, Karachi, Pakistan). Pak. J. Sci. Ind. Res.; 15: No. 3, 164-167(Jun 1972).

Biological half-life of ^{32}P, when injected to immature and mature locust adults, was found to vary from 4.3 to 5.4 days to 4.5 to 6.2 days respectively. Except in case of mature, tagged males when mated with untreated females radioactivity persisted to a varying extent in the egg-pods and resultant hoppers obtained by mating the tagged mature and immature females, as well as the immature males when mated with opposite untreated sexes. (auth)

731 EFFECT OF METHYLTESTOSTERONE ON ^{45}Ca UPTAKE IN ISOLATED SMOOTH MUSCLE FROM RAT DUODENUM. Hava, M. (Univ. of Kansas, Kansas City). Arch. Int. Pharmacodyn.; 195: 315-319(1972).

Methyltestosterone in concentrations of 10^{-7} to 4×10^{-5} M lowered the uptake of ^{45}Ca in resting isolated smooth muscle from rat duodenum. The decrease in uptake was proportional to the concentration of MTS. Depolarization of the muscle by hypertonic 40 mM KCl increased the ^{45}Ca uptake significantly at 2, 8 and 32 min. This increase was completely blocked by 4×10^{-5} M methyltestosterone. (auth)

732 METABOLISM OF ^{35}S-LABELLED THIOGLYCOLATE. Bakshy, S.; Gershbein, L. L. (Illinois Inst. of Tech., Chicago). Arch. Int. Pharmacodyn.; 197: 5-13(1972).

The injection of ^{35}S-labelled thioglycolate into rats by the i.v. and i.p. routes or i.p. in rabbits at overall dosages of 100 to 200 mg/kg, led to the excretion of over 80% of the label in the urine, the highest activity occurring in the neutral sulfur fraction and the lowest, in the ethereal sulfate. The distribution of ^{35}S was ascertained in the organs of the rat 2 hr after i.v. injection and although the recoveries were low, the label was more prominent in the kidney, small intestine, liver, and stomach. The rate of disappearance of ^{35}S from the whole blood of rats was very rapid, generally less than 3% remaining by the first hour and 0.1% or lower, 4 to 7 hr after i.v. injection. In addition, of the serum proteins analyzed in the rabbit, albumin displayed the highest degree of ^{35}S uptake. However, this value amounted to only 0.14% of the total label 20 min following i.v. administration. (auth)

733 *INFLUENCE OF DRUGS UPON $^{42}K^+$ FLUXES IN* GUINEA-PIG ILEUM IN VITRO. Banerjee, A. K. (Univ. of Glasgow). Arch. Int. Pharmacodyn.; 198: 173-186(1972).

The influence of drugs on the movements of $^{42}K^+$ was studied in strips of guinea-pig ileum. Smooth muscle stimulants acetylcholine, carbachol, histamine, 5-HT, and barium chloride all caused marked increase in efflux and decrease in influx of $^{42}K^+$. In addition, flame photometric measurements of net changes in K^+ at the end of efflux experiments showed that acetylcholine, carbachol, and histamine caused significant net loss of K^+. $BaCl_2$ though it did not induce any significant net loss of K^+, showed such trends. 5-HT, however, was without this effect. The drug antagonists atropine, mepyramine, lysergic acid diethylamide, and papaverine as expected reduced or inhibited respectively the enhanced efflux caused by acetylcholine, histamine, 5-HT, and barium chloride. Papaverine, in addition, caused of its own a decrease in both efflux and influx of $^{42}K^+$. No other antagonist showed such an effect. None of the antagonists showed any net change of K^+ either of their own or in combination with agonists. Adrenaline did not cause any significant changes in either efflux or influx of $^{42}K^+$ but the uptake experiments showed indications of increased influx due to the action of this drug. (auth)

734 UPTAKE AND DISTRIBUTION OF NICOTINE-^{14}C IN FROG RECTUS ABDOMINIS MUSCLE. Weiss, G. B. (Virginia Commonwealth Univ., Richmond). Arch. Int. Pharmacodyn.; 195: 99-108(1972).

The effects of variation of extracellular pH as well as of intracellular pH changes induced by procaine or iodoacetic acid were determined in isolated frog rectus abdominis muscles. Intracellular pH was estimated with ^{14}C-labelled 5,5-dimethyl-2,4-oxazolidinedione. The uptake of nicotine was dependent on the cellular pH gradient. Raising extracellular pH or addition of iodoacetic acid increased the pH gradient and the tissue uptake of methyl-^{14}C-labelled nicotine. Lowering extracellular pH or addition of procaine decreased the pH gradient and nicotine-^{14}C uptake. Efflux of nicotine-^{14}C was increased by a decreased pH gradient and inhibited by an increase in extracellular pH. Apparent changes in efflux rate induced by extracellular pH changes can be attributed to an altered nicotine-^{14}C reuptake. The uptake and movements of nicotine-^{14}C in frog rectus abdominis muscle are qualitatively similar to those previously observed in the less sensitive frog sartorius muscle. (auth)

735 ZINC 65 SECRETION BY THE EXOCRINE PANCREAS OF CHICKS FED SOYBEAN MEAL. Salman, A. J.; Fernandez, R.; McGinnis, J. (Washington State Univ., Pullman). Proc. Soc. Exp. Biol. Med.; 142: No. 4, 1248-1251(Apr 1973).

Chicks were fed unheated or autoclaved soybean meal for 4 wk, and after a fasting period of 6 hr ^{65}Zn was given intramuscularly. At intervals the chicks were killed and gamma activity was measured in the pancreas, liver, intestine, and excreta. Results indicated that chicks fed unheated soybean meal had higher activity of ^{65}Zn than chicks fed autoclaved soybean meal. Excreta of these chicks also had a higher activity than chicks fed autoclaved soybean meal. It was concluded that ^{65}Zn activity in the pancreas decreased rapidly as a result of feeding unheated soybean meal after the fasting period. The data support previous reports that unheated soybean meal induces a hyperplastic change in the organ and that the synthesis of the Zn-containing enzymes is higher. The data also support the hypothesis that unheated soybean meal results in increased release rate and a failure to increase synthesis to compensate for continuous depletion. (HLW)

Plants

Refer also to abstract 740.

736 QUICK DETERMINATION OF RADIOACTIVE CONTAMINATION IN FOOD. Seher, A.; Zippel, O. (Bundesanstalt fuer Fettforschung, Muenster, Ger.). Fette-Seifen Anstrichm.; 74: No. 10, 595-598(1972). (In German).

Beta particles were measured in food contaminated with radioactivity by the use of a methane-Ar counting tube having a large surface, in which the γ rays are eliminated. The observed impulse rates are not only dependent on the activity present, but also on the energy of the β radiation. If the contamination is due to an unknown mixture of nuclides, the degree of contamination can be determined by measurements with and without the insertion of suitable Al foils. The resulting decrease in pulse rate, which is dependent on energy, yields the data required for the calculation of activity that reveals the composition of the mixture with respect to low and high energetic components. By this procedure activity of radioactive contamination in food can be determined with fairly good accuracy in 20 g samples of the crushed material without chemical treatment. (GF)

New Tracer Techniques

737 (CONF-711101-) CLINICAL USES OF RADIONUCLIDES: CRITICAL COMPARISON WITH OTHER TECHNIQUES. Proceedings of a Symposium Held at Oak Ridge Associated Universities, November 15-19, 1971. AEC Symposium Series 27. Goswitz, F. A.; Andrews, G. A.; Vlamonte, M. Jr. (eds.) (Oak Ridge Associated Universities, Inc., Tenn. Medical Div.). Dec 1972. 718p. Dep. NTIS $13.60.

The diagnostic values of radioisotope procedures are compared with other diagnostic techniques in a series of 34 papers by physicians who have had wide experience in the procedures and in interpreting the results. Emphasis is placed on scintigraphic and roentgenographic procedures that are of proven value. Each series of presentations is devoted to a specific organ system and is followed by a discussion. An effort is made to evaluate each procedure in terms of costs and potential risks to the patient in relation to the diagnostic value of the information obtained. (CH)

738 (LBL-1722) *RADIOIODINE-123 FOR APPLICATIONS IN DIAGNOSIS.* Myers, W. G.; Anger, H. O.; Lamb, J. F.; Winchell, H. S. (California Univ., Berkeley. Lawrence Berkeley Lab.). Mar 1973. Contract W-7405-eng-48. 8p. (CONF-730309-4). Dep. NTIS $3.00.

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973).

The physical properties of 13-h ^{123}I make it the ideal radionuclide among the 30 nuclides of iodine for most uses in diagnosis. The 159-keV γ rays (84%) have half-thicknesses in water of 4.7 cm, in NaI of 0.36 cm, in lead of 0.037 cm. Calculated photopeak detection efficiency in the 1.3-cm-thick NaI crystal of the Anger Camera is ~90%, which is ~3-fold greater than for the 364-keV γ^+ rays of ^{131}I. Unfortunately, ^{123}I emits five additional γ rays having energies in the 274 to 530 keV range, in ~3% of the disintegrations. Iodine-123 emits no β particles, and the average energies of the conversion and Auger electrons are low relative to those of the β particles of ^{131}I; localized radiation exposures from ^{123}I cannot exceed several percent of those from ^{131}I. The 19-h average life closely matches the times usually involved in studies of iodine

metabolism. Thus, not only is radiation greatly reduced further, but repetitive and confirmatory studies thereby are facilitated. Moreover, the low radiation from ^{123}I gives less cause for concern in conventional uptake studies; and even routine imaging of its distribution may be contemplated as an important additional advantage. Thus, much more informative thyroid evaluation studies become feasible, to supplant the limited usefulness of simple ^{131}I uptake measurements. Images made with the pinhole camera demonstrate superior resolution to those obtainable with ^{131}I. . Iodine-123 lacks four of the neutrons of stable ^{127}I. This neutron deficiency requires cyclotrons or other accelerators to generate it. These now are being used to produce ^{123}I in a variety of nuclear reactions, and in purities adequate for use clinically. One supplier bombards ^{122}Te (enriched to greater than 95%) with deuterons to provide ^{123}I that is contaminated at the time of calibration with only ≃2% of a combination of ^{124}I, ^{126}I, ^{130}I, and ^{131}I. A dose of 100 μCi of this ^{123}I and its contaminants gives a maximum exposure of less than 6 rad to the thyroid gland and 20 mrad to the whole-body. (auth)

739 *(UCRL-Trans-1494)* UTILITY OF THE SCINTILLATION CAMERA AS A "HUMAN WHOLE-BODY COUNTER" FOR THE STUDY OF THYROID CANCER. Hoefer, R.; Willvonseder, R. Translated by H. G. Parker from J. Radiol., Electrol., Med. Nucl.; 51: No. 11, 671-673(1970). 7p. Dep. NTIS $3.00.

The use of the gamma camera as a human whole-body counter can be recommended for use following the administration of a tracer dose of ^{131}I for the observation of patients with metastases from cancer of the thyroid gland following thyroidectomy. The deviations in the results of measurements caused by redistribution are negligible. There is some advantage in localizing the metastases simultaneously with the numerical measurements. (auth)

740 PENETRATION AND TRANSLOCATION OF ^{14}C-LINDANE IN PEA PLANTS. Charnetski, W. A.; Lichtenstein, E. P. (Univ. of Wisconsin, Madison). J. Econ. Entomol.; 66: No. 2, 344-349(Apr 1973).

The effects of ^{14}C-lindane concentrations around pea roots on the penetration into roots, its translocation into greens, and the distribution of ^{14}C-lindane between roots, cotyledons, and greens were investigated. In addition, the production of water-soluble metabolites was measured, after plants had grown in ^{14}C-lindane-treated nutrient solutions or sand. With increasing concentrations of the insecticide in sand, its penetration and translocation in pea plants reached plateaus when a concentration of 180 ppM in roots and 9 ppM in greens was reached. This corresponded to concentrations of ^{14}C-lindane in sand at 16 and 6 ppM, respectively. The insecticide was mostly concentrated in root tips. Plants growing in ^{14}C-lindane-treated nutrient solutions or sand contained 70% of the totally recovered radiocarbon in roots and 6% in the greens after a growing time of 1.5 days. These figures were 25 and 50% respectively, after 30 days of growing time. A decrease in the amounts of hexane-soluble ^{14}C-compounds and an increase in water-soluble ^{14}C-compounds occurred with time, indicating a metabolism of the insecticide into water-soluble compounds. Plants, after growing in ^{14}C-lindane-treated nutrient solutions for 1.5 days, were also transferred into lindane-free nutrient solutions. Within one day, these plants released close to 60% of their total radiocarbon into this surrounding nutrient solution. This radiocarbon was associated with the hexane extraction phase and was identified by GLC and TLC as primarily lindane. (auth)

741 BOLL WEEVILS: TAGGING FOR HIBERNATION AND FIELD STUDIES. Mitchell, H. C.; McGovern, W. L.; Cross, W. H.; Mitlin, N. (Agricultural Research Service, Mississippi State, MS). J. Econ. Entomol.; 66: No. 2, 563-564(Apr 1973).

A study was conducted on boll weevils (Anthonomus grandis) for the purpose of developing a tagging method using a radioisotope that would remain on the weevil in sufficient quantities that they could be found and would not have adverse effects on the insect. The elytra were painted with blue Testors butyrate dope mixed with ^{65}Zn or ^{32}P. Weevils in the field could be detected at a distance of 76 to 91 cm when they were tagged with ^{65}Zn and at a distance of 95 cm when they were tagged with ^{32}P. No adverse effects of the radioisotopes on the weevils were found. (HLW)

742 ION-EXCHANGE MEASUREMENT IN BIOLOGICAL SAMPLES BY (p,x) AND (p,p) REACTIONS. Demortier, G.; Lefebre, J.; Gillet, C. (Univ., Namur, Belg.). J. Radioanal. Chem.; 12: No. 1, 277-285(Oct 1972).

International meeting on chemical analysis by charged particle bombardment; Namur, Belgium (6 Sep 1971).

A method of analysis by ion-exchange in biological samples using (p,x) reactions and back-scattering of charged particles is proposed. Sensitivity and rapidity are the principal qualities of this method. (auth)

743 APPARENT COOPERATIVITY IN RADIOIMMUNOASSAY OF HUMAN CHORIONIC GONADOTROPIN. Weintraub, B. D.; Rosen, S. W.; McCammon, J. A.; Perlman, R. L. (Massachusetts General Hospital, Boston). Endocrinology; 92: No. 4, 1250-1255(Apr 1973).

Eight of 11 guinea pig antisera to human chorionic gonadotropin (hCG) examined in radioimmunoassay showed enhanced binding of labeled hCG after addition of small increments of unlabeled hCG. Gel chromatography of one antiserum revealed that this effect was attributable to antibodies on the 7S class. Mild papain digestion of the anti-hCG produced a modified antibody, possibly divalent $F(ab)_2$, which showed enhanced binding and univalent Fab, which did not. These data indicated that the effect was related to the multivalence of antibodies, and tended to exclude a variety of other possible explanations. Various binding analyses suggested that the data were consistent with positive cooperativity between the two combining sites of a small population of antibodies. However, it is not clear whether the apparent cooperativity of the multivalent antibodies results from allosterism, or is related to another mechanism of enhanced binding. (auth)

744 PHYSICAL CHARACTERIZATION OF hFSH AND ITS DESIALYLATION PRODUCTS BY ISOELECTRIC FOCUSING AND ELECTROPHORESIS IN POLYACRYLAMIDE GEL. Sherins, R. J.; Vaitukaitis, J. L.; Chrambach, A. (National Institutes of Health, Bethesda, MD). Endocrinology; 92: No. 4, 1135-1141 (Apr 1973).

Iodinated and tritiated derivatives of highly purified hFSH were characterized by polyacrylamide gel electrophoresis (PAGE) at pH 7.8 and 10.2, 0°C, and by isoelectric focusing in polyacrylamide gel (IFPA). ^{125}I- and ^{3}H-hFSH appear homogeneous in PAGE, as evidenced by single, linear Ferguson plots at the two pH values, and by a single peak in IFPA. ^{131}I-hFSH in contrast appears heterogeneous. The physical characteristics of hFSH, recognized most comprehensively by the parameters K_R (retardation coefficient, a measure of molecular size) and Y_0 (a measure of molecular net charge) in PAGE, differed significantly between ^{3}H- and ^{125}I-hFSH: it appeared that the tritiated hormone was in an aggregated form at pH 10.2. However, the molecular size of ^{3}H-hFSH appeared the same at pH 7.8 as that of ^{125}I-hFSH at pH 10.2: both values correspond to a mol wt of 36,000, in agreement with literature values. Size discrepancy between 2 variously labeled preparations under a single set of PAGE conditions implies that recognition of various hFSH species in biological systems is feasible only when a single type of isotopic labeling is used. The pH value associated with ^{3}H-hFSH and ^{125}I-hFSH in IFPA was 4.0 ± 0.2 (SD), in agreement with unlabeled hormone. Progressive desialylation of urinary hFSH resulted in species of hFSH that were characterized by pH values increasing from 4 to 6. The estimate of molecular size based on PAGE and the estimate of pI based on IFPA are in reasonable agreement with previous data obtained by other methods. PAGE and IFPA were demonstrated to be sensitive, rapid and reliable methods for the detection of hFSH and the various desialo-hFSH species. (auth)

745 PURIFICATION, CHARACTERIZATION, AND COMPARISON OF IMMUNOLOGICAL PROPERTIES OF MONKEY CHORIONIC SOMATOMAMMOTROPIN WITH HUMAN AND MONKEY GROWTH HORMONE, HUMAN CHORIONIC SOMATOMAMMOTROPIN AND OVINE PROLACTIN. Vinik, A. I.; Kaplan, S. L.; Grumbach, M. M. (Univ. of California, San Francisco). Endocrinology; 92: No. 4, 1051-1064(Apr 1973).

A method is presented that utilizes ammonium sulfate precipitation, pH and alcohol fractionation, and a final Sephadex G-100 chromatographic step for small scale purification of monkey chorionic somatomammotropin (mCS) from rhesus monkey placentae. Recoveries average 15 mg/kg placenta, one-sixth the estimated content. A radioimmunoassay for mCS was established in which human and monkey growth hormone and hCS react minimally and OP does not cross-react. Identical curves of displacement of labeled mCS from antisera to mCS by placental extracts and pregnant monkey plasma indicate that mCS is the material circulating in plasma of pregnant rhesus monkeys and is unaltered from mCS found in crude placental extracts. (MCG)

746 DISCREPANCIES BETWEEN RADIOIMMUNOASSAYS AND BIOASSAY FOR RAT FSH: EVIDENCE THAT ANDROGEN TREATMENT AND WITHDRAWAL CAN ALTER BIOASSAY/IMMUNOASSAY RATIOS. Diebel, N. D.; Yamamoto, M.; Bogdanove, E. M. (Indiana Univ., Bloomington). Endrocrinology; 92: No. 4, 1065-1078(Apr 1973).

An antiserum generated against partially purified rat pituitary FSH was used to develop a radioimmunoassay (RIA). This RIA was tested in parallel with the two other RIA systems for rat FSH that are currently available. Testing included use of a group of rat pituitary and serum samples in which widely varied ratios of FSH, LH and TSH bioactivities had been produced by appropriate

pretreatments of the donors. Minor quantitative disagreements were found among the three RIA systems but marked differences were found between the RIA systems and FSH bioassay. These differences were most evident as changes in the index of discrimination (bioassay/immunoassay ratio) following orchidectomy and/or androgen treatment. Although such treatments alter FSH: LH ratios and these antisera do appear to cross-react with LH (and also with rat serum proteins) the major discrepancies between bio- and immunoassay do not appear attributable to LH cross-reaction since the "FSH" immunoreactivity of purified rat LH (NIAMD rat LH-I-1) is too low to account for them. The data thus suggest that androgen treatment and withdrawal may alter the molecular form of FSH in the rat. (auth)

747 MYOSIN CHAINS OF MYOCARDIAL TISSUE. I. Purification and Immunological Properties of Myosin Heavy Chains. Wikman-Coffelt, J.; Zelis, R.; Fenner, C.; Mason, D. T. (Univ. of California, Davis). Biochem. Biophys. Res. Commun.; 51: No. 4, 1097-1104(16 Apr 1973).

An antiserum specific to dog myocardial myosin has been developed against highly purified myosin heavy chains. The antiserum is specific for the heavy chains of myosin, giving a single precipitin line in an immunodiffusion assay for either the heavy chains of myosin or native myosin, and does not react with any other myocardial proteins. In such assays myosin acts as a single, uniform antigen. Using this antiserum, a radioimmunoassay has been developed to quantitate myosin in a homogenate of myocardial tissue containing free myosin dissociated from other cellular components. (auth)

748 NEUTRALIZATION OF PRIMATE CHORIONIC GONADOTROPIN ACTIVITIES BY ANTISERA AGAINST THE SUBUNITS OF HUMAN CHORIONIC GONADOTROPIN IN RADIOIMMUNOASSAY AND BIOASSAY. Hodgen, G. D.; Nixon, W. E.; Vaitukaitus, J. L.; Tullner, W. W.; Ross, G. T. (National Institutes of Health, Bethesda, MD). Endocrinology; 92: No. 3, 705-709 (Mar 1973).

Antisera to the subunits (α and β) of human chorionic gonadotropin (hCG) were used in radioimmunoassay (RIA) and in neutralization of biological activity measured by rat uterine weight bioassay (RUW) to test for the presence of common antigenic determinants between the subunits and chorionic gonadotropins from the human, gorilla (gCG), chimpanzee (chCG), and rhesus monkey (mCG). Urinary kaolin-acetone extracts of gCG and chCG, as well as native hCG, inhibited antibody binding of both ^{125}I labeled hCG-α and hCG-β in their respective immunoassay systems, but mCG was ineffective in RIA for either of the hCG subunits. Although RUW responses to hCG, gCG and chCG were neutralized by varying quantities of each antiserum, neither antiserum to hCG-α nor hCG-β inhibited the biological activity of mCG. Evidence was obtained by both RIA and RUW neutralization studies for similarity of antigenic determinants in preparations of gCG, chCG and hCG and the subunits of hCG. (auth)

749 NEW METHOD OF DETERMINATION OF THE ENZYMATIC ACTIVITY OF TRYPSIN USING HAEMOGLOBIN LABELLED WITH ^{131}I ISOTOPE. Bogoniowska, Z.; Lipinski, S.; Stelmasiak, T. (Agricultural Isotope Lab., Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Biol.; 20: 147-153(1972).

A method was developed for determination of the enzymatic activity of trypsin, based on the hydrolysis of hemoglobin labeled with ^{131}I. The enzymatic activity was expressed as the percentage of substrate radioactivity following the reaction of the TCA-soluble product (peptide). Kinetics of the reaction were measured as a function of time and enzyme concentration. The enzymatic activity of a number of trypsin preparations was measured. The substrate identity of the normal and the labeled hemoglobin was confirmed. The results obtained with use of the radiometric method and by titration were compared. (auth)

750 MEASUREMENT OF THE RATE OF STOMACH EMPTYING USING ^{113m}In AND A 10-CRYSTAL RECTILINEAR SCANNER. Coates, G.; Gilday, D. L.; Cradduck, T. D.; Wood, D. E. (Toronto General Hospital). Can. Med. Ass. J.; 108: No. 2, 180-183(20 Jan 1973).

Accurate reproducible measurements of the rate of gastric emptying were only possible since the advent of external radionuclide detection techniques. Indium-113m and a 10-crystal rectilinear scanner were employed to measure stomach emptying rates. The technique is simple, the results reproducible and it has proved ideal for assessing the results of drug therapy in patients with gastric retention. In the normal individual, the T50% was 42 to 95 min, and the relationship between counts and time was, to first approximation, a linear function. (auth)

751 ^{113m}In-ALBUMEN MICRO-SPHERES FOR PERFUSION SCINTIGRAPHY OF THE LUNGS. Luetgemeier, J.; Hebestreit, H. P. (Univ., Heidelberg). Fortschr. Geb. Roentgenstr. Nuklearmed.; 118: No. 2, 200-206(1973). (In German).

In order to reduce radiation dose during lung scintigraphy, ^{99m}Tc-macro-aggregates and microspheres were employed. At present, the best combination appears to be ^{113m}indium bound to microspheres. Pulmonary and total-body dose can be reduced by this method to 10%. With the dose used in human medicine, toxic and immunological effects do not occur. (auth)

752 BIOLOGICAL AND METHODOLOGICAL SIGNIFICANCE OF VARIOUS TYPES OF RADIOACTIVITY MEASUREMENTS IN METABOLIC STUDIES. Matsuoka, O. (National Inst. of Radiological Sciences, Chiba, Japan). Proc. Jap. Conf. Radioisotop.; No. 10, 451-453(Apr 1972). (In Japanese).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

Significance and problems in every method of sampling, whole-body counting, fluid measurement, autoradiography, chromatography, and continuous $^{14}CO_2$ measurement in expiration, are described. Criteria for the selection of these methods are whether quantitative or qualitative variation of the object is utilized, what kind of radiation is emitted, and what character the required data have. Since they have both advantages and disadvantages, it is effective to combine them according to the purpose. (Japan)

753 LABELLING OF LYMPHOID ORGANS BY INTRAVENOUS INJECTION OF LARGE DOSES OF ^3H-THYMIDINE. Sainte-Marie, G.; Messier, B. (Univ. of Montreal). Rev. Eur. Etud. Clin. Biol.; 17: No. 9, 839-846(Nov 1972).

A heterogeneous, but relatively weak labeling of the lymphoid organs of rats is produced by administering a single 1-μCi dose of ^3H-thymidine/gram of body weight. An attempt was made to discover whether larger doses would label these organs homogeneously at least as intensely as other organs. Autoradiographs taken over a thirty day period exhibited more intense and more homogeneous images than those produced with a 1-μCi source, doses of between 5 and 10 μCi being required for the spleen, 10 to 20 μCi being required for the nodes, slightly higher doses being required for the Peyer patches, and doses of at least 40 μCi being required for the thymus. The autoradiographs obtained with a 1-day exposure for the higher doses presented the same defects as those with the 1-μCi dose. The labeling defects are thus not corrected with the higher doses but simply masked. The disadvantages of insufficient labeling in the study of the renewal of lymphoid populations is discussed. (France)

754 MICRO-CHROMATOGRAPHIC AND RADIOCHEMICAL ANALYSIS OF GLYCOPEPTIDES. Lehman, E. D.; Hudson, B. G.; Ebner, K. E. (Oklahoma State Univ., Stillwater). J. Chromatogr.; 76: No. 2, 345-350(28 Feb 1973).

A sensitive radiochemical method for monitoring glycopeptides eluted from chromatographic columns was developed. The method, based on the reduction of carbohydrates with sodium-[^3H]borohydride after hydrolysis of the glycopeptides, resulted in a hundredfold increase in sensitivity over the anthrone method. The use of the reducing method to determine carbohydrates, in addition to the use of an analytical gel filtration column, permitted the resolution of milligram quantities of glycopeptides and yet 90% of the material remained for subsequent structural analyses. (auth)

755 ASPECTS OF THE PRESENT STATUS AND THE PROBABLE FUTURE DEVELOPMENT OF ISOTOPE TRACER TECHNIQUES IN LIFE SCIENCE. Noguchi, Teruhisa (Nippon Soda Co., Ltd., Tokyo). Proc. Jap. Conf. Radioisotop.; No. 10, 273-275(Apr 1972). (In Japanese).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

The elucidation of life phenomena at the molecular level has been based on the use of radioisotope tracers. The following elements can be listed as bio-isotopes utilized at present; the isotopes of the constituent elements of a living body such as ^3H, ^{14}C, ^{15}N, ^{18}O, and ^{35}S, halogen isotopes such as ^{18}F, ^{36}Cl, ^{82}Br, and ^{131}I, and metallic isotopes such as ^{24}Na, ^{35}Mg, ^{55}Fe, ^{60}Co, ^{64}Cu, ^{65}Zn, ^{85}Sr, and ^{203}Hg. By using the isotopes, determination can be made of the biosynthesis and metabolism of proteins and nucleic acids in a living body. Metabolism and decomposition of the foreign elements to the living body, and the ecological cycle of agricultural insecticides and industrial wastes can be made clear. For the tracer technique in life sciences, the utilization of short half-life radioisotopes is required, and rapid and stable supply of ^{11}C, ^{13}N, ^{15}O, ^{18}F, etc., and establishment of a simple radioactivity-determining method are expected. (Japan)

756 GAS CHROMATOGRAPHIC AND RADIOMETRIC STUDY OF THE BEHAVIOR OF ^{14}C-DDT ON MUSTARD PLANTS UNDER TROPICAL CONDITIONS. Baig, M. M. H.; Khan, M. S.; Khan, N.; Ferhat, S.; Hossain, A.; Osmani, M. J. A.; Lord, K. A. (Toxicol-

ogy and Pesticides Lab., Karachi, Pakistan). Pak. J. Sci. Ind. Res.; 15: No. 3, 220-226(Jun 1972).

The behavior of a DDT emulsifiable concentrate sprayed on mustard plants was examined under tropical conditions using chemical and radiochemical techniques. The steady loss of DDT from the surface of leaves, measured as surface radioactivity, was closely similar to the loss assessed by washing the insecticide from leaves with hexane and measuring it by gas chromatography and radiometry. About one quarter remained on leaf surfaces 2 days after spraying and less than one-tenth remained after 10 days. After 2 to 4 days about one-fourth of the DDT had penetrated into leaves, as shown both by chemical and radiochemical measurements of insecticide that could be extracted from leaves after washing the surfaces with hexane. The amount of DDT in the plant diminished with time although radiometric assay indicated a faster loss than chemical assay. Most of the radioactivity found appeared to be present as DDT although there was gas chromatographic evidence of some slight degradation of DDT. It is concluded that loss was mainly by volatilization. (auth)

757 EFFECTS OF HEMICHOLINIUM-3 (HC-3) ON IN VIVO INCORPORATION OF ^{14}C-CHOLINE INTO RAT LIVER MICROSOMAL PHOSPHOLIPID. Mohrman, M. E.; Domino, E. F. (Univ. of Michigan, Ann Arbor). Arch. Int. Pharmacodyn.; 196: 192-200(1972).

Male adult albino Holtzman rats were given 150 μg/kg or 150 mg/kg of HC-3 and 30.3 μc/kg of ^{14}C-choline, i.p., and sacrificed two hrs later. For control purposes other rats received 0.6 mg/kg d-tubocurarine i.p. under similar conditions. Animals showing symptoms of respiratory distress were artificially ventilated. Two hrs after drug injection all animals were decapitated and their livers removed for determination of ^{14}C-choline incorporation into microsomal (Mic) phospholipid. After homogenization in 0.3 M sucrose followed by suitable centrifugation, the Mic pellet was extracted with methanol-chloroform. The evaporated extract was applied to silicic acid columns for separation of neutral lipids and phospholipids. Total phospholipid and the isolated phospholipids obtained from thin layer silica gel chromatography were analyzed for phosphorus content as well as radioactivity to obtain specific activities. HC-3 (150 μg/kg) caused signs of toxicity, but did not inhibit the uptake of ^{14}C-choline into total phospholipids and phosphatidylcholine. A slight enhancement of choline incorporation was found, which was not statistically significant ($P < 0.2$), when compared with the corresponding controls ($n = 11$). When all control animals were pooled ($n = 27$) a significant increase in incorporation was observed ($P < 0.005$). In the larger dose (150 mg/kg), HC-3 inhibited ^{14}C-choline uptake into the liver as well as its incorporation into total phospholipid and phosphatidylcholine. d-Tubocurarine, which caused neuromuscular paralysis had no significant effect on the incorporation of ^{14}C-choline into Mic phospholipid. (auth)

758 EFFECT OF DECONJUGATED AND CONJUGATED BILE SALTS ON THE INTESTINAL UPTAKE OF RADIO-VITAMIN B_{12} IN VITRO AND IN VIVO. Coronato, A.; Glass, G. B. J. (New York Medical Coll., NY). Proc. Soc. Exp. Biol. Med.; 142: No. 4, 1345-1348(Apr 1973).

Deconjugated cholic acid decreased the intestinal uptake of radio-B_{12} by the guinea pig intestinal mucosal homogenate by 50 to 55%. It also decreased the absorption of radio-B_{12} in 2 normal adult volunteers as measured by the double label hepatic uptake test. Cholic acid was felt to produce this decrease by a direct toxic effect on the ileal mucosa. Deoxycholic acid was found to produce a slight but not statistically significant decrease in the uptake of radio-B_{12} by the guinea pig intestinal mucosal homogenate. Glycocholic acid, and glycodeoxycholic acid had no statistically significant effect on radio-B_{12} uptake by the guinea pig intestinal mucosal homogenate. (auth)

MATERIALS

759 ERGEBNISSE DER HOCHVAKUUMTECHNIK UND DER PHYSIK DUENNER SCHICHTEN. Band II. (Results in High Vacuum Technology and the Physics of Thin Films. Volume II). *Auwaerter, M. (ed.). Stuttgart; Wissenschaftliche Verlagsgesellschaft mbH (1971).* 483 p. (In German and English). DM-142.-.

Twenty-seven papers, with English abstracts, are included. Separate abstracts were prepared for three of the papers. *(DLC)*

For abstracts of individual papers see: 760, 761, and 825.

760 SURFACE PROBLEMS IN SPACE RESEARCH. Fitton, B.; Trendelenburg, E. A. (European Space Research Organization, Nordwijk, Netherlands). pp 143-174 of Ergebnisse der Hochvakuumtechnik und der Physik Duenner Schichten. Band II. Auwaerter, M. (ed.). Stuttgart; Wissenschaftliche Verlagsgesellschaft mbH (1971).

This review covers surface physics problems related to space instrumentation and those related to outer space phenomena. Discussed under instrumentation are detectors; mirrors, polarizers, and filters for the vacuum uv; and photomultipliers. Under outer space are discussed reentry effects; passive thermal stabilization of satellites; photoemission from satellite surfaces; work function uniformity; interstellar grains; and lunar surface dust. (24 figures, 84 references) (DLC)

761 THIN FILMS DEPOSITED BY EVAPORATION AND SPUTTERING: A COMPARATIVE STUDY. Mayer, H. (Technische Univ., Clausthal-Zellerfeld, Ger.). pp 221-243 of Ergebnisse der Hochvakuumtechnik und der Physik Duenner Schichten. Band II. Auwaerter, M. (ed.). Stuttgart; Wissenschaftliche Verlagsgesellschaft mbH (1971). (In German)

The characteristics of the evaporation and sputtering processes for the deposition of thin films are discussed and compared in detail. The relative merits of each process are worked out and listed. An account is given of the state of the art of thin films deposited by both processes. (100 references) (auth)

Ceramics and Cermets

Refer also to abstracts 232, 824, 837, 1096, 1572, 1606, and 1623.

762 (AREAEE-159) EFFECT OF TEMPERATURE AND EXTENSION RATE ON THE TENSILE PROPERTIES OF SAP. Shafie, A. M.; El-Shanshoury, I. A.; Hammad, F. H. (Atomic Energy Establishment, Cairo (Egypt). Dept. of Metallurgy). 1972. 18p. Dep. NTIS (U. S. Sales Only) $3.00.

The tensile properties of ISML-SAP containing 4 and 7% Al_2O_3 were investigated at extension rates varying from 1×10^{-4} to 8×10^{-2} sec^{-1} in the temperature range, 25 to 670°C. The specimens were found to retain their strength at temperature 10°C higher than the melting point of Al for both SAP alloys. This behavior was attributed to the presence of honeycomb structure of Al_2O_3 embedded in the Al matrix as suggested by Sherby and Coworkers. The ductility of SAP alloys generally decreased as the extension rate decreased. SAP-4% Al_2O_3 exhibited high ductility in the temperature interval 300 to 500°C and severe embrittlement at temperatures near the melting point. Al SAP-7% Al_2O_3 showed embrittlement at the temperature intervals 150 to 550°C and maximum ductility at temperatures around the melting point of Al. The dependence of the magnitude of ductility drop on temperature and extension rate indicated that the process responsible for ductility drop is diffusion controlled. Explanations in terms of pore formation and impurities were given. (auth)

763 (BARC-632) SPECTROGRAPHIC ANALYSIS OF BORON NITRIDE FOR TRACE IMPURITIES. Vengsarkar, B. R.; Machado, I. J.; Malhotra, S. K. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 22p. Dep. NTIS (U. S. Sales Only).

A dc arc emission spectrographic method for determination of Al, As, Bi, Ca, Fe, Mg, Pb, Sb and Sn in boron nitride is described. The method consists of exciting, in a dc arc at 10 A, a charge of 30 mg containing boron nitride and graphite in equal quantities. The mixture contains 2% NaF as a carrier and 1% lanthanum oxide as an internal standard. The spectra are recorded on Hilger's large quartz spectrograph in the region 2400A to 3350A. The method is useful in the determination of impurities in the range of 2 to 1000 ppM for different impurities with a mean percentage standard deviation of ±13%. (auth)

764 (BMI-1725) CONSOLIDATION AND CLADDING OF TUNGSTEN-UO_2 WITH REFRACTORY METALS. Cover, P. W.; Ashurst, A. N.; Alexander, C. A.; Gripshover, P. J.; Hodge, E. S. (Battelle Columbus Labs., Ohio). 10 May 1965. Contract W-7405-eng-92. 43p. Dep. NTIS $4.25.

Declassified 13 Apr 1973.

Consolidation and cladding of tungsten-50 vol. % UO_2 with various refractory metals by gas-pressure bonding and high-temperature reactions of UO_2 with such materials were studied. Tungsten, rhenium, molybdenum, tungsten-26 wt % rhenium, and molybdenum-50 wt % rhenium were considered. Tungsten-50 vol. % UO_2 powder compacts having uniform dispersions of UO_2 shot were achieved without use of a binder. After vacuum outgassing and presintering at 900°C in hydrogen, specimens with densities up to 99% of theoretical were obtained by gas-pressure bonding 3 and 6 h at 1650°C and 10,000 and 20,000 psi. Use of a tantalum foil getter in the bonding container resulted in improved microstructure and density. Cladding surface preparation by grinding to a roughness below 10 μin. rms was found satisfactory. Of the materials studied as claddings, high cost and potential difficulties with intermetallic-compound formation made rhenium unattractive, and molybdenum and molybdenum-rhenium alloy were rejected because of excessive fuel loss at 2500°K and selective diffusion into tungsten. Tungsten and tungsten-26 wt % rhenium showed the most promise. The alloy is perhaps superior since grain enlargement occurred in the tungsten cladding during vacuum heat treatment at 2500°K which could induce embrittlement and the formation of diffusion paths. (auth)

765 (CEA-CONF-2186) TWO VO_2 THIN FILM DEVICES: A THRESHOLD SWITCH AND A DICHROMIC DISPLAY. Duchene, J.; Guyon, P. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). 17 Jul 1972. 16p. (CONF-720211-1). Dep. NTIS (U. S. Sales Only) $3.00.

From solid state circuits conference; Philadelphia, Pennsylvania, USA (16 Feb 1972).

The crystalline vanadium dioxide VO_2 undergoes at 68°C a semiconductor-to-metal phase transition accompanied by a discontinuous resistivity change of about five orders of magnitude and associated 15% variation of the optical refractive index. The former property can then be used to realize a thin-film threshold switching device based on the Joule heating of the oxide film when an external voltage is applied between the electrodes. A display based upon the change of the refractive index of VO_2 at the transition is described. (6 figures) (auth)

766 (CEA-R-4408) PYROX HEATING ELEMENT FOR HIGH TEMPERATURES IN AIR. Moise, A. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Feb 1973. 26p. (In French). Dep. NTIS (U. S. Sales Only) $3.50.

High-temperature electrical kilns in air or oxygen are very interesting but have limitations. A study was made of the possibility of heating elements with a new conductive refractory oxide compound: lanthanum chromite. In order to improve its properties, the influences of some additives were studied. Thus, vaporization, hydration tendency, electric conductivity, densification, could be considerably modified. Studies led to different models of heating elements: split tubes, welded tubes, heating rods, etc. Experimental kilns are shown. Some other applications are mentioned. (auth)

767 (CEA-R-4409) ELASTIC CONSTANTS OF LiH BETWEEN 300°K AND 77°K. Terras, C. (Commissariat a l'Energie Atomique, Bruyeres-le-Chatel (France). Centre d'Etudes). Mar 1973. 9p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

From measurements of the elastic constants, the Debye temperature extrapolated to 0°K: $\Theta_D = 1156$°K is in good agreement with Debye temperatures of other lithium halides, but it is higher than the theoretical value of Θ_D. The elastic anisotropy factor decreases with temperature. The calculated lattice energy is $U_0 = 221.8$ kcal/mole. (auth)

768 (DP-Report-663) DEVELOPMENTS IN THE ELECTROLYTIC ETCHING OF PYROLYTIC SILICON CARBIDE. Dragon Project. Willis, M. (Atomic Energy Establishment, Winfrith (England)). Sep 1969. 28p. Dep. NTIS (U. S. Sales Only) $3.50.

Developments are described in etching of silicon carbide coatings deposited pyrolytically onto fuel particles for the Dragon Reactor Experiment. The developments are in the field of electrolytic etching, and details are given of the method employed, the electrolytes used, and a selection of typical results in the form of photomicrographs. The problems associated with working

on the Dragon Project coated particles, in particular their small size and the difficulty in making good electrical contact with the silicon carbide are discussed. Also discussed are the reasons for adopting the various etchants and apparatus used, and the different features revealed by the etching process. (auth)

769 (IS-Trans-90) MOBILITY OF HYDROGEN IN TRIVALENT RARE EARTH HYDRIDES. Viallard, R.; Daou, J. N. (Paris Univ. (France). Laboratoire de Chimie Physique). Apr 1973. Translation of a French paper. 15p. Dep. NTIS $3.00.

The hydrogen mobility is studied from the resistivity and NMR results for the three cases corresponding to the three varieties of hydrides which a trivalent lanthanide metal usually forms with the hydrogen. In the α and β(H) phases, the hydrogen would diffuse according to the usual mechanism for interstitial solid solutions. The activation energies as well as the frequency factors are determined for both α and β(H) phases of, respectively, the Lu–H and La–H (or D) systems. The place of the dihydrides among the metal hydrides is recalled and characteristics of the Ln–H bond are discussed from the resistivities of eight lanthanide dihydrides. At comparatively moderate temperatures, the participation of the point defects, in this case Schottky defects of the Ln atoms sublattice, to the intralattice diffusion is used as an explanation of the thermal behavior of these compounds. (auth)

770 (ITJ-34) TABLES OF MAGNETIC PROPERTIES. Part I. Cubic System. a. Spinels. Cofta, H.; Kurzynski, M.; Mionas, R.; Oles, A. (Institute of Nuclear Techniques, Krakow (Poland)). Nov 1972. 82p. Dep. NTIS (U. S. Sales Only) $6.25.

The tables consist of two parts. The first one gives the data taken directly from original papers: Curie or Néel temperature, Weiss (or asymptotic or paramagnetic) temperature, the Curie constant, saturation magnetization, anisotropy constants, and exchange integrals, as well as some other parameters. The second part comprises the temperature or magnetic field dependences of some magnitudes in the form of diagrams, copied exactly from the original literature and sometimes also from review works. The fascicle includes 42 cubic compounds that crystallize in the spinel structure, and contains 110 figures and about 450 literature references. (auth)

771 (N–72-30598) FABRICATION OF (U,Zr)C FUELED/TUNGSTEN-CLAD SPECIMENS FOR IRRADIATION IN THE PLUM BROOK REACTOR FACILITY. (Gulf General Atomic, Inc., San Diego, Calif.). 12 Jul 1972. Contract NAS3-13471. 39p. (NASA-CR–120946; GULF-GA-A-12121). NTIS.

Fuel samples, 90UC–10 ZrC, and chemically vapor deposited tungsten fuel cups were fabricated for the study of the long-term dimensional stability and compatibility of the carbide–tungsten fuel–cladding systems under irradiation. These fuel samples and fuel cups were assembled into the fuel pins of two capsules, designated as V-2E and V-2F, for irradiation in NASA Plum Brook Reactor Facility at a fission power density of 172 watts/c.c. and a maximum cladding temperature at 1823°K. Fabrication methods and characteristics of the fuel samples and fuel cups are described. (auth) (STAR)

772 (NIIAR-P-125) DURING- AND POST-IRRADIATION INVESTIGATION OF PORCELAIN CONDUCTIVITY IN A HIGH-FLUX REACTOR. Aseev, N. A.; Samsonov, B. V.; Tsykanov, V. A. (Scientific Research Atomic Reactor Inst., Melekess (USSR)). 1971. 23p. (In Russian). INIS.

Changes in the conductivity of porcelains of various compositions as a result of SM-2 reactor irradiation are reported. The conductivity of inorganic ceramic dielectrics under irradiation is made up of several components (temperature, ionization, and dose) corresponding to the activation energy of the carriers. (tr-auth)

773 (STI/PUB-308) NEUTRON INELASTIC SCATTERING, 1972. Proceedings series. Proceedings of a Symposium, Grenoble, France, 6-10 March 1972. (International Atomic Energy Agency, Vienna (Austria)). 1972. 913p. (CONF-720304-). IAEA $30.00.

From fifth IAEA symposium on neutron inelastic scattering; Grenoble, France (6 Mar 1972).

The following sessions were held in this symposium: phonons, molecular crystals, polymers and chemistry, liquids, magnetism, instrumentation, and phase transitions. Separate abstracts were prepared for 17 of the 69 papers presented at the symposium. The remaining ones were not sufficiently within the subject scope of NSA to be included. (RWR)

For abstracts of individual papers see: 130, 501–505, 580–583, 776, 851–853, 1202, 1281, and 1648.

774 (WAPD-TM–1092) EFFECTS OF THERMAL GRADIENTS IN OXIDE FUELS. LWBR Development Program. Cohen, I. (Bettis Atomic Power Lab., Pittsburgh, PA). Mar 1973. Contract AT(11-1)-Gen-14. 32p. Dep. NTIS $3.75.

ThO_2 and ThO_2–10 wt % UO_2 compositions have been studied as part of development work for the Light Water Breeder Reactor (LWBR). Thermal gradient experiments, designed to simulate conditions encountered during irradiation, were conducted to study the microstructural changes which occur in these fields. Thermal gradient runs with ThO_2–10 wt % UO_2 annular pellets were made at ID temperatures of 2700 to 3000°C and at OD temperatures of 1300 to 1500°C. Runs with ThO_2 annular pellets were made with an ID temperature of 2700°C and OD temperatures of 1550 to 1600°C. The origin of lenticular shaped pores generating columnar grains was discussed. The velocity of pore movement was measured and compared with analytical predictions. Grain growth measurements were made and activation energies were calculated. The grain size-time relationship could be expressed by the equations: $D^4 - D_0^4 = kt^{0.93}e^{-88,000/RT}$ (ThO_2) and $D^4 - D_0^4 = kt^{0.90}e^{-102,000/RT}$ (ThO_2–10 wt % UO_2). (auth)

775 CHARGED PARTICLE BOMBARDMENT FOR STUDYING OXYGEN SELF-DIFFUSION IN OXIDES. Calvert, J. M.; Lees, D. G.; Derry, D. J.; Barnes, D. (Univ. of Manchester, Eng.). J. Radioanal. Chem.; 12: No. 1, 271-275(Oct 1972).

International meeting on chemical analysis by charged particle bombardment; Namur, Belgium (6 Sep 1971).

The various nuclear techniques which have been used to study oxygen self-diffusion in oxides are discussed. Results are given for measurements using resonance capture in the $^{18}O(p,\alpha)^{15}N$ and $^{18}O(p,\gamma)^{19}F$ reactions and the different techniques are compared. (auth)

776 SUMMARY OF THE SYMPOSIUM ON NEUTRON INELASTIC SCATTERING. Jacrot, B. (Institut Max von Laue–Paul Langevin, Grenoble, France); Kroo, N.; Springer, T. pp 859-865 of Neutron Inelastic Scattering, 1972. Vienna; International Atomic Energy Agency (1972).

From fifth IAEA symposium on neutron inelastic scattering; Grenoble, France (6 Mar 1972). See STI/PUB-308; CONF-720304-.

Areas considered in this summary are successively molecular crystals, polymers, liquids, phonons, and magnetic systems. Existing studies of the dispersion curves for external vibrations are based on a very simple model: a molecule is considered as a rigid body that vibrates harmonically around its average position in the lattice. The interaction is then described by means of a van der Waals potential between pairs of atoms in two different molecules. Neutron inelastic scattering experiments enable testing of the validity of such models. Another type of experiment on molecular crystals is concerned with disorder in orientation. Neutron scattering experiments can yield information on the geometry of these reorientations, provided a single crystal can be used. Experiments on incoherent scattering by polymers are addressed to Van Hove-type singularities, mainly those connected with optical branches. The existence of deuterated and oriented crystals makes it possible to obtain phonon dispersion curves in these materials. In particular, the average value of the dispersion curve in a plane perpendicular to the axis of a polymeric chain can be determined, and this provides information about the binding forces between the chains. The reorientation motions that can occur for chain segments or for certain molecular groups in a chain must also be considered. It has become obvious that the typical features in the spectra of solids are not at all pronounced in liquids. In the frequency range accessible with the present neutron techniques no clear evidence of the existence of phonon-type excitations in liquids has been found (at least, not in liquid noble gases). In contrast to normal liquids, "solid-like" collective excitations can be observed in superfluid He. The theory for incoherent scattering in hydrogenous molecular liquids agrees with experiment within the errors. A first approach to a microscopic theory of phonons in simple solids has been made by introducing a pseudopotential for the atoms, the electron-cloud contribution being described by a screening function which is a dielectric function. There seem to be two types of Kohn anomalies: the first is related to the shape of the Fermi surface and allows its shape to be defined; the second is connected with the lattice geometry and can be considered an indicator of lattice instability. A fcc phase of solid He has been discussed. Research on excitations in magnetic systems remains an important application of neutron scattering techniques. By this means a comprehensive study of magnetic systems in one and two dimensions has been carried out. A great deal of important research has been devoted to studies of critical phenomena in magnetic systems. For EuO the dynamic scaling law predicted the dependence of certain quantities on temperature and wave vector. These predictions have been confirmed. The modes associated with impurities in magnetic materials are similar to the local modes for phonons. The

frequencies of local modes, the spreading of these modes in the lattice, and the perturbation of lattice spin waves have been successfully measured and have yielded data that are in excellent agreement with theoretical calculations. In some rare earth compounds the ground level of an ion in the crystalline field is a nonmagnetic state; however, such compounds can become ferromagnetic or antiferromagnetic at low temperature. This is due to mixing of the low levels and the excited levels, fostered by the exchange interaction. Theory predicts that at the transition point the energy of one of these excited states should approach the energy of the ground state. The experiments on TbSb and Pr_3Tl prove that this is not the case. (RWR)

777 THERMOLUMINESCENCE AND ACTIVATION ENERGIES IN Al_2O_3, MgO, AND LiF(TLD-100). Ziniker, W. M.; Rusin, J. M.; Stoebe, T. G. (Univ. of Washington, Seattle). J. Mater. Sci.; 8: No. 3, 407-414(Mar 1973).

Thermoluminescent characteristics of Al_2O_3 and MgO single-crystal samples obtained from several sources were determined after x-ray and ultraviolet irradiation. The glow peak spectrum above room temperature, the emission spectrum, the impurity content and distribution, and the activation parameters for the observed glow peaks are reported. Czochralski-grown Al_2O_3 samples indicate a major glow peak, the position of which shifts to lower temperatures with increasing dose, an observation with interesting implications in thermoluminescent radiation dosimetry. MgO also has characteristics that could be useful in dosimetry, especially in the ultraviolet region. Activation parameter comparisons are made for the observed glow peaks in Al_2O_3 and MgO and in LiF(TLD-100). After considering a number of theoretical and experimental problems and uncertainties, it is concluded that determinations of activation parameters are less meaningful than observations of other thermoluminescent characteristics in the understanding of thermoluminescent behavior. (auth)

778 OXYGEN PRESSURES OVER FAST-BREEDER-REACTOR FUEL. I. A MODEL FOR $UO_{2\pm x}$. Blackburn, P. E. (Argonne National Lab., IL). J. Nucl. Mater.; 46: No. 3, 244-252 (Apr 1973).

A model was developed for calculating oxygen pressures for uranium oxide compositions in the range from the UO_{2-x} metal-rich boundary to $UO_{2.1}$. The model is based on the law of mass action, the free energy of formation of UO_2 and U_4O_9, and phase boundary data. Oxygen pressures calculated with the model are in excellent agreement with experimental observations. (auth)

779 POROSITY DEPENDENCE OF THE THERMAL CONDUCTIVITY FOR NUCLEAR FUELS. Ondracek, G.; Schulz, B. (Kernforschungszentrum, Karlsruhe, Ger.). J. Nucl. Mater.; 46: No. 3, 253-258(Apr 1973).

A critical consideration is given to equations used in several papers to describe the dependence of thermal conductivity on porosity. It is shown that the only method of derivation justified physically is that starting from the general field equation. In this way, following the methods of Maxwell, Bruggeman and Niesel, two equations were derived, the calculated values of which agree closely with the experimental values of the thermal conductivity for porous UO_2 and UN. In these equations two clearly defined stereometric factors appear, which take into account the effect of the shape and the orientation of the pores on the thermal conductivity. These factors can be calculated by using stereometric data measured in the microstructural sections. The reason one obtains two equations lies in the fact that two types of porosity occur: closed isolated as well as interconnected porosity. The equations and their means of derivation are explained. (30 references) (auth)

780 THERMAL CONDUCTIVITY OF NEUTRON-IRRADIATED PYROLYTIC β-SILICON CARBIDE. Price, R. J. (Gulf General Atomic Co., San Diego, CA). J. Nucl. Mater.; 46: No. 3, 268-272 (Apr 1973).

Samples of pyrolytic β-silicon carbide deposited at 1400°C (grain size ~1 μm) and at 1750°C (grain size ~3 μm) were irradiated with fast neutrons to 2.7 to 7.7 × 10^{21} n/cm^2 (E > 0.18 MeV) at 550 to 1100°C. Irradiation reduced the room-temperature thermal conductivity from ~0.15 cal/cm · sec · °C to ~0.02 cal/cm · sec · °C after irradiation at 550°C and to ~0.05 cal/cm · sec · °C for an irradiation temperature of 1100°C. The thermal conductivity of unirradiated samples decreased with increasing measurement temperature, while that of the irradiated samples was much less temperature-dependent. No difference in behavior was found between the samples with ~1 μm grain size and the samples with ~3 μm grain size. (auth)

781 THERMAL CONDUCTIVITY OF UO_2 AND U_4O_9 FROM 100 TO 300 K. Kamimoto, M.; Murabayashi, M.; Takahashi, Y.; Mukaibo, T. (Tokyo Univ.). J. Nucl. Mater.; 46: No. 3, 309-314(Apr 1973).

The thermal diffusivities of UO_2 and U_4O_9 were measured by the laser flash method at temperatures ranging from 100 to 300°K. The phonon mean free path and the thermal conductivity were calculated from the obtained thermal diffusivity data and the heat capacity. The structure of the U_4O_9 is closely related to the UO_2 structure with an excess oxygen atom per unit cell in U_4O_9. As the excess oxygen atoms increase the anharmonicity of the lattice vibration, the phonon mean free path in U_4O_9 decreases. Therefore, the thermal conductivity of U_4O_9 is much lower than that of UO_2 and increases slightly with increasing temperature due to the rise in heat capacity. (auth)

782 PERTURBED ANGULAR CORRELATION STUDIES OF RARE EARTH NUCLEI IMPLANTED INTO CUBIC METALS. Gebbie, D. W. Madison, WI; Univ. of Wisconsin (1972). 172p. University Microfilms Order No. 72-29,487.

The ion implantation perturbed angular correlation technique was used in both the integral and time differential modes to study the large attenuations that occur when rare earth nuclei are implanted into simple metals. A 25-MeV ^{16}O beam was used to Coulomb excite the rare earth nuclei ^{154}Sm, ^{162}Dy, ^{170}Er, and ^{174}Yb and to implant them into the cubic metals of Al, Cu, Rh, and Ag. The observed attenuations as a function of temperature were interpreted in the Abragam and Pound formalism as due to a predominantly time-dependent magnetic interaction caused by a fluctuating 4f shell on the ion. The measured attenuations for the diamagnetic cases of ^{174}Yb in Al and Ag show the presence of a static electric quadrupole interaction probably arising from radiation damage to the cubic lattice. The Yb data were used to correct the Dy and Er data for this same effect and to fit all the data to a theory combining a time-dependent magnetic attenuation with that of a static electric quadrupole interaction. Temperature-dependent measurements show that the reciprocal of the correlation time for these time-dependent interactions varies linearly with temperature due to an exchange scattering interaction between the 4f-shell electrons and conduction electrons of the metal host. The relationship between the temperature-dependent part of the electron paramagnetic resonance linewidth and the temperature dependence of the correlation time is discussed. The perturbed angular correlation results are compared to recent theoretical calculations that include the effects of the crystal field on the correlation time for rare earth ions implanted in metals of cubic symmetry. (Diss. Abstr. Int., B)

783 INTERNAL FRICTION DUE TO DOMAIN BOUNDARIES IN NIOBIUM HYDRIDE. Amano, M.; Matsumoto, T.; Sasaki, Y. (National Research Inst. for Metals, Tokyo). Scr. Met.; 7: No. 4, 371-375(Apr 1973).

The internal friction in Nb-42.8 at.% H alloy was measured in the temperature range -160 to 200°C. The observed peaks are discussed compared with electrical resistance measurement and differential thermal analysis. Besides the peaks caused by the phase transformations or the presence of oxygen, the -35°C peak and additional internal friction were found and they were considered to be associated with the domain boundaries in the hydride phase. The peak may be caused by the cooperative motion of hydrogen atoms at domain boundaries, and the additional internal friction is attributed to the irreversible movements of the domain boundaries. (auth)

784 STATISTICAL MECHANICS OF A THREE-COMPONENT SYSTEM: Pd-B-H. Mehlmann, R.; Husemann, H.; Brodowsky, H. (Univ., Muenster, Ger.). Ber. Bunsenges. Phys. Chem.; 77: No. 1, 36-41(1973).

The mixing behavior of the binary systems Pd-H and Pd-B is applied to the ternary system Pd-B-H. The Fermi energy contribution to the thermodynamic properties is treated strictly as a known function of the total valence electron concentration, which is in agreement with magnetic susceptibility measurements on these systems. The quasi-chemical approach, which was used to calculate the thermodynamic properties connected with the energy of attraction in the binary systems, is extended to the three-component system Pd-B-H. In addition to the known energies of attraction between two like particles, there appears a third parameter, the energy of attraction between unlike particles. The method is applied to hydrogen absorption measurements on Pd-B alloys. A good fit is obtained with one adjustable parameter, the interaction energy between unlike particles. (GF)

785 PECULIARITIES OF ELECTROPHYSICAL PROPERTIES IN Mo_2B_5 AND W_2B_5. Samsonov, G. V.; Goryachev, Yu. M.; Kovens'ka, B. O. (Inst. of Problems in Materials Science, Kiev). Dopov. Akad. Nauk Ukr. RSR, Ser. A; No. 10, 943-946(Oct 1972). (In Ukrainian).

Electric conductivity and thermoelectric power of Mo_2B_5 and W_2B_5 at 300 to 1300°K, as well as the Hall coefficient at room temperature, were measured. Calculation was carried out for the

basic parameters of current carriers in a two-band model approximation, taking into account an essentially different degeneration degree for different bands. (auth)

786 HIGH OXIDE ION CONDUCTION IN SINTERED OXIDES OF THE SYSTEM Bi_2O_3–WO_3. Takahashi, T.; Iwahara, H. (Nagoya Univ., Japan). J. Appl. Electrochem.; 3: No. 1, 65-72(Feb 1973).

The ionic conduction in sintered oxides of the system Bi_2O_3–WO_3 was investigated by measuring conductivities and ion transference numbers under various conditions. The ion transference number was measured by an oxygen concentration cell employing the specimen tablet as the electrolyte. It was found that a compound, $3Bi_2O_3 \cdot WO_3$, and its solid solution were high oxide ion conductors, the conductivities of which were about one order of magnitude higher than those of the well-known oxide ion conductors such as stabilized zirconias. In contrast to pure Bi_2O_3 which is a completely electronic conductor below 730°C, these materials showed high oxide ion conduction even below 700°C accompanied by little electronic conduction. $3Bi_2O_3 \cdot WO_3$ has the face-centered-cubic structure, probably of the fluorite type, and the oxide ion conduction was thought to be attributed to the migration of oxide ion vacancies in the crystal. (auth)

787 NUCLEAR FUEL PRESSING PROCESS. Hagie, L. T.; Ryer, C. M. (to General Electric Co.). U. S. Patent 3,720,739. 13 Mar 1973. Filed date 14 Apr 1969. 10p.

A pressing technique for producing nuclear fuel pellets for use in nuclear reactors is disclosed. Typically, an active nuclear fuel material is pressed at a pressure of from about 6000 to about 10,000 psi and a temperature from about 900 to about 1300°C for about 3 to about 20 minutes. For good results, it is necessary that full pressure be applied before the temperature is increased to the temperature at which significant plastic flow begins in the fuel material. (auth)

788 INTERACTION OF OXIDES OF RARE EARTH ELEMENTS WITH MOLYBDIC ANHYDRIDE. Mokhosoev, M. V.; Get'man, E. I.; Alekseev, F. P.; Loboda, S. N. (Donetsk State Univ., USSR). Zh. Neorg. Khim.; 18: No. 3, 593-595(Mar 1973). (In Russian).

A study of the chemical reactions between the oxides of MoO_3 and the rare earth oxides showed that the first reaction product was a phase of unknown composition, which was studied by x-ray and thermographic techniques. In the case of the systems involving the oxides of Gd, Dy, Y, or Ho, the structure of this new "X phase" was similar to the structure of the high-temperature modification of typical rare earth molybdates. Where Ln represents Y or any of the rare earth elements, the mechanism of the reactions occurring is suggested as: $Ln_2O_3 + MoO_3 \xrightarrow{440-490°C} X + Ln_2O_3 + MoO_3 \xrightarrow{510-580°C} Ln_2O_3 \cdot 4MoO_3 + Ln_2O_3 \xrightarrow{590-670°C} Ln_2O_3 \cdot 3MoO_3 + Ln_2O_3 \xrightarrow{750-825°C} Ln_2O_3 \cdot MoO_3$. (KSW)

789 ANNEAL CHARACTERISTICS OF ION-IMPLANTED ZnO. Thomas, B. W.; Walsh, D. (Oxford Univ.). J. Phys., D (London); 6: No. 5, 612-615(20 Mar 1973).

Ion implantation of P, V, N, O, Ar, and Ne into n-type Li-doped ZnO was investigated with energy up to 300 keV at dose levels 10^{12} to 10^{16} cm^{-2}. Measurements of sheet conductivity and Hall mobility as a function of anneal temperature gave evidence of n-type layers after P and V implantation, with sheet conductivities 10^5 times higher than unimplanted and Ar-implanted material. It was also found that an isochronal anneal sequence, terminated by a 1-h, 450°C vacuum anneal and then a water quench, is sufficient to remove most of the electrical effects of damage produced by ion implantation. (auth)

790 LOW-TEMPERATURE PHASE TRANSITION NEAR V_3H_2. Asano, H.; Hirabayashi, M. (Tohoku Univ., Sendai). Phys. Status Solidi (a); 16: No. 1, 69-72(16 Mar 1973).

Heat capacity measurements were made on V–H alloys with the compositions $VH_{0.51}$ to $VH_{0.77}$ in the temperature range from −140 to 50°C. Anomalous heat absorptions are observed at −100 to −50°C depending on composition, indicating the occurrence of a phase transition attributed to the hydrogen ordering. A model of the superstructure of V_3H_2 is proposed for the low-temperature form on the basis of electron diffraction work by Wanagel et al. (auth)

791 PREPARATION OF A RHOMBOHEDRAL BORON CARBIDE OF COMPOSITION $B_{13}C_2$. Ploog, K. (Univ., Bonn). J. Less-Common Metals; 31: No. 1, 177-180(Apr 1973). (In German)

$B_{13}C_2$ was prepared by pyrolysis of gaseous BBr_3–CH_4–H_2 in a flowing system at 1550 to 1650°C. The $B_{13}C_2$ crystals were in the form of pyramid-formed aggregate with pentagonal and hexagonal surfaces. X-ray analysis resulted in a_{hex} = 5.617 Å and c_{hex} = 12.099 Å (rhombohedral: a_{rh} = 5.175 Å, α = 65.72°). It is very probable that in most cases, B_4C is a solid solution of C in thermodynamically stabilized $B_{12}CBC \cong B_{13}C_2$. (DLC)

792 OBTAINING DISPERSIONS OF CARBIDES AND NITRIDES IN IRON. Thibaudon, D.; Roubin, M.; Paris, R. A. (Univ., Lyon). J. Less-Common Metals; 31: No. 1, 69-82(Apr 1973). (In French).

Dispersions of refractory carbides and nitrides in iron were prepared by chemical means at temperatures below 1000°C. A gas–solid reaction was used with mixtures of H_2–CH_4 or H_2–NH_3 on suitable starting materials. With carbonizing and nitriding treatments it is not possible to obtain dispersions in iron directly. An additional treatment is necessary to eliminate iron nitrides or iron carbide Fe_3C. The thermal stability of the different phases was evaluated precisely and products were obtained which are characterized by a homogeneous distribution of the dispersed phase in the matrix. (auth)

793 GAS-PHASE SEPARATION OF ELEMENTAL BORON AT SUBSTRATE TEMPERATURES 1100 TO 1400°C. Ploog, K. (Univ., Bonn). J. Less-Common Metals; 31: No. 1, 15-34(Apr 1973). (In German).

By the vapor-phase reduction of BBr_3 with H_2 on Ta wires heated to 1100 to 1400°C, two crystalline polymorphs of elementary boron can be prepared, i.e. II-tetragonal boron, B_{192}, (a = 10.12, c = 14.14 Å; d = 2.36 g ml^{-1}; space group: $P4_122$) formed at substrate temperatures of 1150 to 1200°C, and β-rhombohedral boron, B_{105}, (a_{hex} = 10.94, c_{hex} = 23.81 Å; d = 2.33–2.35 g ml^{-1}; space group $R\bar{3}m$) deposited at 1400°C and higher substrate temperatures. In addition to different nucleation energies, the most important criterion for the vapor-phase deposition of a definite boron modification at T_s < 1500°C is the nature of the $B_xBr_yY_z$ clusters in the gas phase, as the gaseous monomeric boron species prefer, in the growth process, icosahedral clusters of 12 or more B atoms which are already present in the vapor phase and which are then arranged in relation to one another as if they were large single atoms with strongly directed bonds. Therefore the choice of reaction conditions must always be a compromise between the best conditions for the polymerization reactions in the vapor phase and the best conditions for successful nucleation and crystal growth. Reaction conditions required for reproducible deposits of particular boron polymorphs in the experimental arrangement used are described. In addition, investigations are reported which elucidate the processes leading to the growth of different boron modifications by vapor-phase reduction. (auth)

794 REGIONS OF GLASS FORMATION IN SYSTEMS OF $M_2O_3(MO_2)$–TeO_2–V_2O_5 (M_2O_3 = B_2O_3, Al_2O_3, In_2O_3, Sc_2O_3, Y_2O_3, La_2O_3, Pr_2O_3, Ga_2O_3, NdO_3, MO_2 = CeO_2, SnO_2). Dimitriev, I. B.; Marinov, M. R.; Ivanova, I. L; Lakov, L. (Higher Inst. of Chemical Tech., Sofia). Compt. Rend. Acad. Bulg. Sci.; 25: No. 11, 1533-1536(1972).

An experimental study was made of the glass-forming capacity in the systems of $M_2O_3(MO_2)$–TeO_2–V_2O_5, where M_2O_3 is an oxide of Group III and MO_2 is CeO_2 or SnO_2. The region of glass formation decreases with increasing atomic number in both III A and III B subgroups. The crystallization capacity is considerable (it lies low, not exceeding 300 to 500°C), the softening temperature reaches 450°C, and high electric conductivity (10^{-5} to 10^{-9} ohm cm^{-1}) is common. Results are discussed in relation to glass classification schemes. The structures of TeO_2 and V_2O_5 and of B_2O_3 show antagonism which is an obstacle to vitrification. (DLC)

795 THERMODYNAMIC PROPERTIES OF ThC–UC SOLID SOLUTIONS. Osaki, M.; Obata, N.; Kirihara, T. (Nagoya Univ., Japan). J. Jap. Inst. Metals; 37: No. 1, 100-103(Jan 1973). (In Japanese).

The partial molar free energies of thorium in ThC–UC solid solutions were measured from 700 to 950°C by means of the solid-state galvanic cells of the type Th, $ThF_4/CaF_2/ThF_4$, $Th_{1-x}U_xC$. The following results were obtained: (1) The partial molar free energy of thorium in ThC–UC solid solution increases negatively with decreasing thorium content, and the absolute value of partial molar entropy of thorium shows a maximum near $Th_{0.5}U_{0.5}C$. (2) As the ThC–UC solid solution is assumed to be a quasi-binary system of thorium and uranium, the partial molar free energy of uranium was calculated from that of thorium, and the free energy of mixing was estimated. (3) The interaction energy between thorium and uranium in Th–U–C system was calculated according to a model of the strictly regular solution. The interaction between thorium and uranium is attractive and its temperature dependence corresponds fairly well with partial molar entropy of thorium in ThC–UC solid solution. (auth)

796 VOZDEYSTVIYE REAKTORNOGO OBLUCHENIYA NA STRUKTURU I RAZLICHNYYE SVOYSTVA KRISTALLICHESKOGO I PLAVLENOGO KVARTSA. (Effect of Pile Irradiation on Struc-

ture and Various Properties of Crystalline and Fused Quartz). Moscow; Moscow State University (1971). 131p.

A survey is made of data in the literature on the effect of pile irradiation on various physical properties of crystalline and fused quartz: density, refractive index, specific rotation, elastic constants, thermal and dielectric properties, absorption spectra, Raman spectra, x-ray photographs, etc. The analogy between a radiative and temperature $\alpha-\beta$ transition is considered, as well as the effect of annealing on radiation effects. The general pattern of radiation damage in fast neutron-irradiated quartz is discussed. (236 references) (JPRS)

797 CROSS RELAXATION IN γ-IRRADIATED RUBY. Brown, M. A.; Challis, L. J.; Moore, W. S.; Yalcin, T.; Waldorf, D. L. (Univ. of Nottingham, Eng.). J. Phys., C (London); 6: No. 6, 1063-1073(28 Mar 1973).

Measurements were made of the increase, following γ irradiation, in the spin–lattice relaxation rate of Cr^{3+} ions in ruby and of the reduction of this produced by subsequent ultraviolet irradiation. Measurements of the changes in strength of the resonant phonon scattering at ~6 cm^{-1} produced by the same treatments showed that the additional relaxation rate was proportional to the strength of the resonant phonon scattering over much of the range. It is concluded that both effects are due to Cr^{2+} ions and that the limiting process in the relaxation is cross relaxation between Cr^{3+} and Cr^{2+} ions. In the crystals used, the mean chromium ion separation was ~40 Å and the cross-relaxation time at 4.2°K was ~1.2×10^{-4}s. (auth)

798 NONLINEAR VARIATION WITH APPLIED FIELD OF THE MOBILITY OF MAGNETIC DOMAIN WALLS IN YTTRIUM ORTHOFERRITE. Ikuta, T.; Shimizu, R. (Osaka Univ.). J. Phys., D (London); 6: No. 5, 633-640(20 Mar 1973).

The mobilities of the magnetic domain wall in yttrium orthoferrite, $YFeO_3$, as grown by the flux method were investigated by the bubble collapse method. The observed relationship between the domain wall velocity and the drive pulse field was nonlinear, having the following features: (i) an initial low-mobility slope (~25 cm $s^{-1}Oe^{-1}$); (ii) a transition region; and (iii) an ordinary high-mobility slope (~2000 cm $s^{-1}Oe^{-1}$). The initial low mobility at low drive field was increased about 2 times after x-ray irradiation. The ordinary high mobility at high drive field was slightly increased after irradiation. The difference in the improvement of mobility at the initial and ordinary slope after x-ray irradiation suggests that the damping mechanism of domain wall motion is not the same for these two regions. (auth)

799 FLUIDIZED BED PRODUCTION OF URANIUM MONOCARBIDE AND URANIUM MONOCARBIDE–URANIUM ALUMINIDE MIXTURES. Hogg, G. W. (to United States Atomic Energy Commission). U. S. Patent 3,715,318. 6 Feb 1973. Filed Date 28 Jan 1971. 6p.

Uranium-dioxide-coated aluminum particles in a fluidized bed can be converted to particles of substantially pure uranium monocarbide or particles with a composition comprising a mixture of uranium monocarbide and uranium aluminide by fluidizing the bed with a mixture of carbon tetrachloride and chlorine in varying percentages with argon gas for 1 to 2 hours at a temperature of 320°C and subsequently fluidizing the bed with argon alone for 1 to 2 hours at a temperature of 800°C. (auth)

Metals and Alloys

800 URANUS 50: AN AUSTENO-FERRITIC STRUCTURED STAINLESS STEEL. Jolly, P.; Droin, R. (Societe Creusot-Loire, Unieux, France). Mater. Tech.; No. 12, 283-290(Dec 1972). (In French).

The properties of Uranus 50 stainless steel (mechanical properties, corrosion resistance) are presented. The principal applications are enumerated: chemical industry, nuclear industry, exploitation of natural gas, uses in seawater and marine environments. (France)

801 HANDBOOK OF METAL POWDERS. Poster, A. R. (ed.). New York; Reinhold Publishing Corporation (1966). 282p.

The book concentrates information on 1,800 standard grades and types of pure and alloyed powders. It provides complete data on their purities, impurities, flow rate, bulk density, covering power, and other physical and chemical properties. Information in the five sections include: characteristics, testing, and applications of metal powders; data on commercially available metal powders; suppliers listing according to metal element and alloy; suppliers listing including address and statement of activities; and an annotation bibliography on production, characteristics, and testing of metal powders. The bibliography is taken from the American Society for Metals Review of Metal Literature, and is arranged by year, covering the years 1950 to 1965. (JCW)

Corrosion and Erosion

Refer also to abstract 222.

802 (CEA-CONF-2194) CARBON MONOXIDE ADSORPTION KINETICS ON MOLYBDENUM (100). Lecante, J.; Riwan, R.; Guillot, C. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 7 Oct 1972. 32p. (CONF-720679-2). Dep. NTIS (U. S. Sales Only) $3.75.

From 2nd symposium on surface physics: the solid vacuum interface; Enschede, Netherlands (22 Jun 1972).

In an ultrahigh-vacuum system (10^{-10} torr) LEED, Auger spectroscopy, flash desorption, and work-function measurements were used to follow the adsorption kinetics of carbon monoxide on the (100) face of a molybdenum single crystal. At room temperature, CO adsorbs into three β states, β_1, β_2, β_3, which are associated with different work-function changes: the β_3 phase is found to correspond to a work-function decrease, whereas phases β_1 and β_2 correspond to an increase. The total change of surface potential is about 0.50 eV at saturation. An ordered C (2×2) structure is found for the $\beta_2 + \beta_3$ phases, which is associated at their maximum coverage (about half a monolayer) with a work-function change of +0.070 eV with respect to the clean surface. A P (1×1) structure is observed on completion of the monolayer. (15 figures, 12 references) (auth)

803 INFLUENCE OF LONG-TERM SODIUM EXPOSURE ON COMPOSITION AND MICROSTRUCTURE OF AUSTENITIC ALLOYS. Sandusky, D. W.; Armijo, J. S.; Wagner, W. J. (General Electric Co., Sunnyvale, CA). J. Nucl. Mater.; 46: No. 3, 225-243(Apr 1973).

Austenitic alloys (Types 304, 316, 321, 347 stainless steel and Incoloy-800) were exposed to flowing sodium in out-of-pile test loops at 704°C and 621°C for varying times up to 15726 h. Changes in chemical composition and microstructure increased with increasing exposure time. Major alloying elements (Cr, Ni, Mn) were depleted from surface layers up to 130 μm thick. Unstabilized alloys (Types 304 and 316) lost carbon during exposure while stabilized alloys (Types 321, 347, and I-800) tended to gain carbon. Variations in other minor elements with exposure were determined. Changes in microstructure reflected the compositional changes in all the alloys. Specimens were examined by optical, transmission electron, and scanning electron microscopy. A ferrite layer formed at the sodium exposed surface of all alloys except Incoloy-800. Sigma phase precipitation increased with exposure time. In the stabilized alloys, cavities formed up to 120 μm below the sodium-exposed surface. The subsurface cavities appeared to be connected to surface pits via intergranular channels and were related to a decrease in density observed in the specimens. (auth)

804 INVESTIGATION OF THE CORROSION MECHANISMS IN TANTALUM–LITHIUM HIGH-TEMPERATURE HEAT PIPES BY ION ANALYSIS. Quataert, D.; Busse, C. A. (CCR-EURATOM, Ispra, Italy). J. Nucl. Mater.; 46: No. 3, 329-340(Apr 1973).

The corrosion mechanism in stabilized-grain-size (S.G.S.) tantalum/lithium heat pipes operated at 1600°C was investigated by metallography and ion analysis. The following results were obtained: (1) The wall material in the condensation zone is deoxidized and grain growth of S.G.S. tantalum follows. (2) The oxygen is carried away by the liquid lithium film towards the heating zone where it is concentrated by fractional distillation of lithium. (3) A liquid Li–O–Y–Ta phase forms which locally attacks the wall material in the heating zone through intergranular corrosion. (4) Failure of the heat pipe occurs through complete perforation of the heat pipe in the corrosion zone. (auth)

805 STRUCTURAL KINETIC INVESTIGATION OF THE OXIDIZABILITY OF ALLOYS HAVING A NICKEL–CHROMIUM BASIS. Abramova, N. B.; Ignatov, D. V.; Lazarev, E. M. (Inst. of Metallurgy, Moscow). Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 5, 775-776(May 1972).

Translated from Zh. Fiz. Khim.; 46: No. 5, 1340-1341(May 1972).

A structural and kinetic investigation was made of the oxidizability at 1000°C of the alloys Ni + 10% Cr and Ni + 10% Cr + 6% W containing 0.2% each of cerium, lanthanum, and yttrium. The addition of rare-earth metals to these alloys diminishes their rate of oxidation by factors of 3 to 8. The greatest thermal stability is exhibited by alloys containing yttrium. (auth)

806 ELECTRODEPOSITION OF COBALT–NICKEL–TUNGSTEN ALLOYS FROM PYROPHOSPHATE ELECTROLYTES.

Sarojamma, M.; Rama Char, T. L. Galvanotechnik; 63: No. 8, 751-761(15 Aug 1972). (In German).

Investigations on the electrodeposition of Co–Ni–W alloys from a pyrophosphate solution at 60°C showed that alloys containing 25 to 67% Co, 16 to 53% Ni and 7 to 36% W gave the most satisfactory results. The pyrophosphate/metal ratio was 3:1. The cathode current efficiency was 9 to 57%, the maximum current density applied being 10 A/dm^2. The structure of the deposits was studied by x-ray methods. The mechanism of the W deposition and the properties of W and Co–Ni alloy anodes are discussed. (36 references) (Metals Abstr.)

807 INITIATION OF CORROSION ON CARBON STEEL. Eklund, G. (Institutet foer Metallforskning, Stockholm). Scand. J. Met.; 1: No. 6, 331-336(1972).

The surface of a polished steel is completely covered with an air-formed oxide film except at the sites of the inclusions. The sulfide inclusions are electronic conductors and can therefore function as local electrodes, and the conductivity can vary between them mainly because of compositional differences. When such a steel is submerged in a corrosive liquid, the sulfide inclusions are polarized towards the potential of the oxide film. During the first minute the sulfides are anodic with respect to the oxide surface of the metal and tend to dissolve, increasing the sulfide-ion activity in their immediate vicinity. The sulfide ions are adsorbed on the nearest oxide layer and the contaminated oxide quickly turns anodic to the rest of the metal surface. The metal starts to corrode, the potential decreases and the sulfides cease to function as starting points. The initial corrosion that takes place on a polished steel surface refers to the condition of the surface at the time of immersion and the tendency of the sulfides to form sulfide ions. It is therefore not possible to relate the initial corrosion to the general corrosion behavior of a steel. (auth)

808 SURFACE OXIDATION OF URANIUM METAL AS STUDIED BY X-RAY PHOTOELECTRON SPECTROSCOPY. Allen, G. C.; Tucker, P. M. (Central Electricity Generating Board, Berkeley, Eng.). J. Chem. Soc., Dalton Trans.; No. 5, 470-474 (1973).

Results indicate that, even at 1073°K in a residual oxygen partial pressure of less than 1×10^{-8} N m^{-2}, the interdiffusion of pure uranium and the surface oxide film is not sufficiently rapid to produce a completely pure uranium surface. Evidence is presented which suggests that, under spectrometer conditions, the surface layer is composed of a mixture of pure uranium, UO_2, and "UO" stabilized by the presence of uranium carbide. It is shown that values previously reported for the binding energies of uranium are in error, and they must have been obtained from an oxidized surface. Accordingly, values believed to be representative of pure uranium are presented. (auth)

809 PHYSICAL STRUCTURE OF ELECTRODEPOSITED CADMIUM–TITANIUM ALLOY. Kim, D. H.; Clark, D. G. Plating; 59: No. 10, 943-947(Oct 1972).

The static fracture strength of steel may be markedly reduced by the introduction of H during electroplating operations. The availability of H to the steel is controlled by the cathode efficiency during plating, but the structure of the deposit is of primary importance in controlling the amount of H remaining after postplate baking. The structure, as determined with a scanning electron microscope and x-ray diffraction, was examined to relate surface features and crystal structure to the porosity of the plate to H. Microstructures observed in the electrodeposited metal were found to be hexagonal in shape and the hcp crystal structure disclosed lattice parameters equivalent to those of Cd which has solidified from the melt. Grain size and texture were varied by adding brightener to the plating solution and were related to H diffusion through the plating. (Metals Abstr.)

810 CADMIUM–COBALT ALLOY DEPOSITION FROM SULFATE BATHS. Dambal, R. P.; Rama Char, T. L. Metal Finish.; 70: No. 11, 34-39(Nov 1972).

Baths containing cadmium sulphate, cobalt sulphate, a sodium acetate buffer, dextrin and ammonium citrate were used to electrodeposit Cd–Co alloys under different conditions with respect to electrolyte concentration, addition agents, pH, temperature, and agitation. The effect of these variables on plate composition, cathode efficiency, and cathode potential is shown by graphs. Data for anode corrosion and deposit structure are also given. (Metals Abstr.)

811 DOES THE OXIDATION OF ZIRCONIUM OBEY WAGNER'S THEORY. Lacombe, P.; Beranger, G.; Boisot, P.; Com-Nougue, U. (Ecole Nationale Superieure des Mines, Paris). Korrosion; No. 23, 114-119(1971).

The use of different experimental analysis methods allowed to evidence a rigorously parabolic law for oxidation of zirconium after an initially disturbed period that has been related to the oxide layer formation is described. The oxygen dissolution in the metal follows a parabolic law right from its start. Wagner's theory relative to diffusion in an homogeneous phase with formation of an oxide layer is in good agreement with the kinetic results. However, this theory should be adapted to take into account the different atomic scale phenomena and especially the oxygen diffusion in zirconium. (GF)

812 ANALYSIS OF STAINLESS STEEL SURFACES BY SECONDARY ION MASS SPECTROSCOPY (SIMS). Huber, W. K.; Loebach, E. (Blazers A. G. fuer Hochvakuumtechnik und Duenne Schichten, Liechtenstein). Vacuum; 22: No. 11, 605-608(Nov 1972).

A commercial secondary ion mass spectrometer is described. It has been used to study surface conditions of stainless steel samples after different commonly used uhv pre-treatment techniques. (auth)

813 RHEED INTENSITIES FROM OXYGEN AND HYDROGEN (2 × 1) SURFACE STRUCTURES ON W(110). Matysik, K. J. Ithaca, NY; Cornell Univ. (1972). 105p. University Microfilms Order No. 73-9355.

Thesis (Ph.D.).

Using a glancing-angle ultra high vacuum electron diffraction camera, oxygen and hydrogen surface structures on a W(110) surface were investigated. Absolute reflectivities of oxygen (2 × 1) surface structure reflections were measured and compared with kinematic diffraction theory. If surface waves were not excited, the observed absolute reflectivities could be described with non-reconstruction Bauer and interstitial models of the surface. The observed absolute reflectivities could not be described on the basis of the Germer–May reconstruction model and it was concluded that this model was not a plausible representation of the surface. It was demonstrated that exposing the W(110) surface to hydrogen resulted in a (2 × 1) surface structure. The structure could be removed by heating the crystal to 550°K. The non-Bragg specular beams were shown to be very sensitive to surface structures. Various calculations of the non-Bragg specular beam intensity were considered, but none adequately described the experimental results. With further development of the theory, the specular beam should prove to be a potentially useful probe of crystal surface. (Diss. Abstr. Int., B)

Preparation and Fabrication

Refer also to abstract 308.

814 (ANL/IF-28524-1) LASER APPLICATIONS FEASIBILITY STUDY. (Holobeam, Inc., Paramus, NJ (USA)). 1972. Contract W-31-109-eng-38. 44p. AT $4.00.

For Argonne National Lab., Idaho Falls, ID.

Experimental results are reported for seven tests of the machining ability of a laser: disassembly of gas-bonded capsules, disassembly of sodium-bonded capsules, removal of a spacer wire from a tube, welding of spacer wires to tube or rod, welding of end cap to capsule, fiducial marking of tubing, and drilling and rewelding of holes in stainless steel tubing. The requirements for the laser system are discussed, and the optical and mounting requirements for use in a hot cell (ANL facility) are considered. Safety features of the Holobeam pulsed laser systems are listed. (DLC)

815 (BDX-613-872) HEAT TREATMENT OF 6Al–4V TITANIUM FORGINGS TO OBTAIN HIGH YIELD STRENGTH. Technological Spinoff Report. Kuehnle, J. H. (Bendix Corp., Kansas City, Mo.). Mar 1973. Contract AT(29-1)-613. 21p. Dep. NTIS $4.00.

Parts machined from titanium alloy 6Al–4V were heat treated to meet a 160,000 psi (1100 MN/m^2) minimum yield strength requirement. This high yield strength was obtained by using a high solution heat treatment temperature of approximately 1780°F, a short solution heat treatment time of 1 hour, and a cold (36 to 40°F) agitated water quench produced by a submerged jet fixture. A high aging temperature of 1100°F for 6 hours was used to partially relieve quenching stress. Forty-five cylinders were treated. Eighteen cylinders had one open end and 27 were shorter and open on both ends. Extensive hardness testing of these parts showed good process uniformity (RC 41.8 ± 2.1). One part of each type was tested. Both parts had acceptable yield strength. (auth)

816 (RFP-1948) INDUCTION MELTING AND CASTING OF U–2.2 wt. % Nb and U–0.75 wt. % Ti. Avery, J. G. (Dow Chemical U.S.A., Golden, Colo. Rocky Flats Div.). 19 Feb 1973. Contract AT(29-1)-1106. 9p. Dep. NTIS $3.00.

Induction melting and casting parameters are described that result in sound, segregation-free ingots of U–2.2 wt % Nb and U–0.75 wt % Ti. (auth)

817 MONOKRISTALLY TUGOPLAVKIKH I REDKIKH METALLOV I SPLAVOV. (Single Crystals of Refractory and Rare Metals and Alloys). Savitskii, E. M.; Burkhanov, G. S. Moscow; Izdatel'stvo Nauka (1972). 258p.

This monograph summarizes data on the production, structure, and properties of single crystals of the refractory and rare metals. The experimental studies of the authors are extensively reported. Modern concepts of the true structure of metal crystals and the nature of the interatomic bond in them are presented. Attention is given to the influence of external actions on the stability of their structure and properties. The primary methods of growing metal crystals are discussed. Problems of the production and study of monocrystals of refractory metal alloys are analyzed. Separate chapters discuss problems of plastic deformation and heat treatment of single crystals of refractory and rare metals. Examples of the application of refractory metal single crystals in technology are presented. The alloys treated include: Mo–Nb, Mo–Ta, W–Ta, W–Mo, Mo–Re, W–Re, Nb–Zr, and Cu–Zn. The properties discussed are: physical properties, mechanical properties, and cold shortness. (DLC)

818 FOCUSING A BEAM OF ELECTRONS. Wilkinson, B. H.; Carradice, W. (to Ministry of Defence). British Patent 1,301,672. 4 Jan 1973. 5p.

A method is described for focusing an electron beam, with particular application to electron beam welding. The method comprises providing at least two removable members so as to define a gap at the desired focusing position, the gap-defining sides of these members being arcuate in the direction of travel of the beam and having a minimum spacing at the focusing position. The apparatus may comprise two spaced cylindrical rollers positioned in or on a support so as to provide a gap between them, the rollers being curved in the direction of travel of the beam and having a minimum spacing at the focusing position. The intensity of the beam passing through the gap is monitored, and means are provided for adjusting the focus in accordance with the monitored intensity. The beam may be continuous or pulsed, and the monitoring means may include a Faraday cup arrangement and an oscilloscope. (UK)

819 RESEARCH INTO THE INCONSISTENCY OF THE PROPERTIES OF WELDED JOINTS IN A ZIRCONIUM ALLOY CONTAINING 2.5% OF NIOBIUM. Steklov, O. I. Weld. Prod. (USSR) (Engl. Transl); 19: No. 4, 47-51(Apr 1972).

Translated from Svar. Proizv.; 19: No. 4, 27-30(Apr 1972).

It is proved that substantial phase and structural heterogeneity, and also inconsistency of the elastic–plastic state, exist in electron-beam-welded joints in an alloy of zirconium containing 2.5% of niobium; this heterogeneity and inconsistency affect the corrosion resistances of the individual zones in welded joints. (auth)

820 ELECTROCHEMICAL METHOD FOR SHAPING METALLIC PARTS. Bonduel, L.; de Fouchier, A.; Lecocq, J. C.; Chombart, D.; Facquet, L.; de Vaulchier du Deschaux, L. (to *Commissariat a l'Energie Atomique*). *French Patent 2,118,312.* 28 Jul 1972. Filed date 17 Dec 1970. 11p. (In French).

A process for shaping U or U alloy parts is presented. The process utilizes electrochemical techniques to remove unwanted material. An electric current is passed between the previously degreased surface to be treated (which forms the anode of the system) and a special tool (which acts as the cathode) maintained close to the part from which the unwanted material is to be removed. An aqueous electrolytic solution containing NO_3 and NO_2 ions and Na, K, or Li ions is circulated between the tool and the part from which the unwanted material is to be removed. In general, a $LiNO_3$, $NaNO_3$, KNO_3, or $NaNO_2$ solution is used (with added HNO_3 when an acid solution is required). This electrolytic solution has a pH of between 0.2 and 12 with a resistivity of less than 4.57×10^{-2} Ω·cm. The pH can be held at a value greater than 10 when the detached U is to be precipitated and subcritical conditions are to be maintained. The removal of unwanted material may follow an electrochemical passivation treatment. (FR)

821 *TECHNIQUES ASSOCIATED WITH THE USE OF SPECIAL METALS. III.* Tantalum and Niobium. Perez, M.; Syre, R. (Societe Trefimetaux, Paris). Mater. Tech.; No. 1, 17-20(Jan 1972). (In French).

Techniques associated with the use of nonalloyed Ta and Nb were studied. Ta and Nb may be easily welded if certain precautions are taken in view of their high reactivities (>200°C) with the N_2 and O_2 of the air and their high melting temperatures. Ta may be brazed to other metals. The degreasing and cleaning of the surfaces does not present particular problems. Thin oxide films can be obtained by anodic oxidation and electrolytic deposition. (France)

822 GROWTH OF SINGLE CRYSTALS FROM A MELT OF SOME RARE EARTH METALS, YTTRIUM, AND THEIR ALLOYS. Sakharov, B. A.; Chuprikov, G. E.; Safronov, E. K.; Epifanova, K. I. (State Scientific-Research and Planning Inst. of the Rare-Metals Industry, Moscow). Dokl. Akad. Nauk SSSR; 207: No. 1, 94-97 (1 Nov 1972). (In Russian).

Single crystals of Gd, Tb, Nd, La, and Y were grown in a vacuum, and their crystallographic orientations were determined by x-ray and metallographic techniques. The structure of the single crystals was characterized by a macro-mosaic substructure. The subgrain was elongated in the direction of growth, the average diameter of these subgrains being from 0.5 to 0.08 mm. (KSW)

823 INFLUENCE OF MELT COMPOSITION ON RATE OF TITANATION OF VN-2 ALLOY. Belyaeva, G. I.; Anfinogenov, A. I.; Ilyushchenko, N. G.; Finkel'shtein, S. D. Tr. Inst. Elektrokhim., Ural. Nauch. Tsentr Akad. Nauk; No. 17, 131-136(1971). (In Russian).

The influence of potassium fluorotitanate, time, and temperature on the rate of titanation of Nb alloy in a chloride melt is studied along with phase composition and heat resistance of the diffusion coating. It is demonstrated that the heat resistance of the titanated alloy is greater than the resistance of pure Nb. (JPRS)

824 SINGLE-LINE COMPOUNDS FOR ^{155}Gd MOESSBAUER SPECTROSCOPY. Prowse, D. B.; Vas, A.; Cashion, J. D. (Monash Univ., Clayton, Australia). J. Phys., D (London); 6: No. 5, 646-650(20 Mar 1973).

The preparation of narrow single-line absorbers of $(Gd_xSc_{1-x})H_2$ and sources of PdEu and $SmPd_3$ for use with ^{155}Gd Moessbauer spectroscopy is described. The methods were developed for use with the small quantities typical with isotopically enriched materials, and should be of general applicability in rare-earth Moessbauer effect studies. (auth)

825 VACUUM METALLURGY OF TRANSITION METALS (RARE METALS). Kieffer, R. (Technische Univ., Vienna); Lugscheider, E. pp 398-422 of Ergebnisse der Hochvakuumtechnik und der Physik Duenner Schichten. Band II. Auwaerter, M. (ed.). Stuttgart; Wissenschaftliche Verlagsgesellschaft mbH (1971). (In German)

After discussing the classification of the metals of the periodic system in common, alloying and rare metals the production of the less common transition metals is described. Their metallurgy is closely connected with vacuum metallurgical techniques as far as metallothermic and carbidothermic methods under vacuum are concerned. In addition to the refining of the transition metals, processes such as floating-zone-melting, sintering, hot pressing, infiltration, melting in arc and electron-beam furnaces, are closely connected with vacuum techniques of various kinds. (8 tables, 14 figures, 59 references) (auth)

826 PURIFICATION OF THE RARE-EARTH METALS. I. SOLID-STATE ELECTROLYSIS OF GADOLINIUM. Jordan, R. G.; Jones, D. W. (Univ. of Birmingham, Eng.). J. Less Common Metals; 31: No. 1, 125-141(Apr 1973).

The utilization of solid-state electrolysis as a purification technique for the preparation of high-purity gadolinium is described and assessed. Using ultrahigh vacuum and a double-cycle technique, the oxygen content in gadolinium was reduced by two orders of magnitude and many other impurities reduced by significant amounts, yielding gadolinium of much higher purity and resistance ratio than previously reported. Additionally, large single crystals are often produced in the purified sample. (auth)

827 PREPARATION AND PURIFICATION OF AMERICIUM METAL BY EVAPORATION. Spirlet, J. C.; Mueller, W. (EURATOM, Karlsruhe, Ger.). J. Less-Common Metals; 31: No. 1, 35-46(Apr 1973).

Several grams of ^{241}Am were prepared by two independent methods: lanthanum reduction of the oxide and thermal dissociation of the intermetallic compound Pt_5Am. After its separation from excess lanthanum or alloy constituent by evaporation, americium metal was further purified by sublimation at 1100°C and 10^{-6} torr. Irrespective of the method of preparation, the temperatures of evaporation or condensation and the material of the condenser, the americium samples displayed the same dhcp crystal structure. As determined by vacuum hot extraction, the oxygen, nitrogen, and hydrogen contents are equal or smaller than 250, 50 and 20 ppM, respectively. (auth)

828 TUNGSTEN MASKING AGAINST BORON IMPLANTATION. Portnoy, W. M. (Texas Tech. Univ., Lubbock); Leedy, L. M. Electron. Lett.; 9: No. 6, 129-130(22 Mar 1973).

Electron-beam evaporated and ion-beam sputtered films have been successfully used as masks against high-dosage boron implantation. Evaporated films were found to be somewhat more effective, probably because of their higher density. The predicted value for the required mask thickness was in satisfactory agreement with the experimentally determined value. (auth)

829 USE OF NITRIDE INTERMEDIATES IN PREPARATION OF METALS: REDUCTION OF Nb_2O_5 WITH NH_3. Guidotti, R. A.; Kesterke, D. G. (Bureau of Mines, Reno, NV). Met. Trans.; 4: No. 5, 1233-1237(May 1973).

A kinetics study of the reduction of Nb_2O_5 with NH_3 was conducted at 600 to 1300°C, using vertical fixed-bed, flow-through reactors, with the goal of using the nitride as an intermediate in the preparation of niobium (columbium) metal via a thermal decomposition step. The effects of reactor materials (stainless steel, nickel, molybdenum, graphite, alumina, and Vycor) upon ammonia reactivity toward Nb_2O_5 were investigated. At low temperatures, the metal reactor systems were more catalytically reactive, yielding faster rates of reaction and a greater degree of nitride conversion, whereas at high temperatures, the nonmetal reactor systems performed better. In general, the initial reaction rate-temperature data exhibited a maximum, associated with oxynitride formation, near 700°C for the metal reactor systems and 800 to 900°C for the nonmetal reactor systems, followed by a minimum, associated with NbO_2 formation, at 800 to 850°C for the metal reactor systems and 950 to 1000°C for the nonmetal reactor systems where NbN formation commences. A second maximum, associated with the hexagonal NbN phase, occurred at 1200°C. The ranges of activation energies for these regions were from 15 to 30 kcal/mole for region I, 8 to 22 kcal/mole for region II, and 10 to 22 kcal/mole for region III. (auth)

Properties, Structure, and Phase Studies

Refer also to abstracts 259, 273, 306, 1357, 1386, 1488, 1621, and 1723.

830 (AD-741217) MEASUREMENTS OF DYNAMIC PROPERTIES OF MATERIALS. Volume VI. Tantalum. Final Report. Isbell, W. M.; Christman, D. R.; Babcock, S. G. (General Motors Corp., Warren, Mich. Materials and Structures Lab.). Feb 1972. Contract DASA01-68-C-0114. 90p. (MSL-70-23(Vol.6); DASA-2501-6). NTIS.

Results of an experimental study on the dynamic properties of tantalum are presented. Areas studied included stress–strain–strain rate and reverse loading behavior, elastic constants, equation of state, compressive and release wave characteristics, and spall fracture. (auth)

831 (ANL-7982) MEASUREMENT OF COLD WORK IN TYPE 316 STAINLESS STEEL. Carson, N. J. Jr.; Steves, C.; Renken, C. J.; Reimann, K. J.; Berger, H. (Argonne National Lab., Ill.). Dec 1972. Contract W-31-109-Eng-38. 37p. AT $4.00.

Changes in the structure of Type-316 stainless steel as it is cold-worked are discussed. Various destructive and nondestructive methods of measuring cold work are presented. The destructive methods applied were microhardness and optical strain. The nondestructive methods were based on magnetic retentivity, ultrasonic critical-angle, and Mössbauer techniques. The advantages and limitations of each method are presented, together with comparable measurements on several sets of test specimens. (auth)

832 (BARC-637) FORMATION OF THE GAMMA PHASE BY A PERITECTOID REACTION IN THE ZIRCONIUM-HYDROGEN SYSTEM. Mishra, S.; Sivaramakrishnan, K. S.; Asundi, M. K. (Bhabha Atomic Research Center, Bombay (India)). 1972. 25p. Dep. NTIS (U. S. Sales Only) $3.25.

Results of studies on the zirconium–hydrogen system have indicated that a peritectoid reaction occurs at about 255°C between the α and δ phases to give the γ phase. This reaction is dependent upon the interfacial contact and hence is sluggish if the two phases are in massive form. The γ is a stable phase of composition ZrH, below 255°C and decomposes rapidly if heated above this temperature to give α and δ phases. Quenched α with saturated hydrogen or δ of high temperature composition precipitate the γ phase at room temperature and require long time for completion of the process. Nonequilibrium δ phase in a 49 (at. %) hydrogen alloy, on β-quenching and room temperature aging may transform fully to γ phase by a shear type of mechanism quite similar to δ to ε transformation. (auth)

833 (CEA-Bib-204) RELIABILITY OF STEELS IN USE. Segot, C. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Feb 1973. 46p. (In French). Dep. NTIS (U. S. Sales Only) $4.50.

The risks of embrittlement and cracking of steels in use are discussed under the following sections: (1) criteria for developing parts, envelopes, and equipment; (2) characteristics of the forming of steels; (3) embrittlement; and (4) cracking. (auth)

834 (CEA-R-4418) PLASTICITY OF A URANIUM–VANADIUM ALLOY (2% BY WEIGHT) IN $\beta \rightleftharpoons \gamma$ TRANSFORMATION. Papet, J. P. (Commissariat a l'Energie Atomique, Valduc (France). Centre d'Etudes). 1973. 129p. (In French). Dep. NTIS (U. S. Sales Only) $8.50.

Thesis. Submitted to Lyon Univ. (France).

Plasticity studies of the $\beta \rightharpoonup \gamma$ transformation of a U–2 wt.% V alloy demonstrated the existence of an enhanced plasticity zone associated with a reduced stress. The existence of the phenomenon was established from heat-cycle tests carried out with a constant load around the transformation temperature and tensile and isothermal torsion tests. The latter tests demonstrated the large deformation capacity available at the moment of the $\beta \rightharpoonup \gamma$ phase change and in the γ region. The phenomenon can be utilized in the die working of such alloys. (auth)

835 (COO-3150-11) EFFECT OF SURFACE CONDITION ON THE TRANSPORT PROPERTIES OF TUNGSTEN. Baer, D. R.; Wagner, D. K. (Cornell Univ., Ithaca, N. Y. Lab of Atomic and Solid State Physics). Feb 1973. 54p. Dep. NTIS $4.75.

Measurements are presented of the low-temperature electrical and thermal resistivities, ρ and W, of several high-purity, single-crystal tungsten rods of various orientations for which the electron mean free path l is larger than the sample diameter d. For the highest-purity samples oriented with a [110] direction parallel to the rod axis, several effects of surface condition on the electron transport properties were observed. Firstly, both ρ and W are increased substantially by sandblasting or electroetching the surface, and reduced correspondingly by electropolishing the surface. Secondly, the temperature-dependent part of the electrical resistivity $[\rho - \rho_0]$ is reduced by sandblasting or electroetching and increased by electropolishing. The corresponding effect is not observed for the thermal resistivity. Thirdly, the Lorenz number extrapolated to T = 0°K, $L(T \rightharpoonup 0) = (\rho/WT)_0$, is found to equal the standard value $L_0 = 2.445 \times 10^{-8}$ WΩ/K² for the sandblasted or electroetched surface, but is reduced significantly (up to 18%) below this value for the electropolished surface. In the latter case, application of a longitudinal magnetic field strong enough to prevent many of the conduction electrons from striking the surface is observed to increase $L(T \rightharpoonup 0)$ to L_0, confirming that this is, indeed, a surface effect. (auth)

836 (FRNC-TH-354) Fe–Yb ALLOY: STUDY OF RELATION BETWEEN THE HYPERFINE FIELD OF AN IMPURITY AND ITS POSITION IN THE CRYSTAL LATTICE. Thome, L. (Paris Univ., Orsay (France)). 1972. 105p. (In French). Dep. NTIS (U. S. Sales Only) $7.25.

Thesis.

An attempt was made to study the effects of point defects created by implantation on the hyperfine interaction of an impurity implanted in Fe. The changes in the hyperfine field and the position of the impurities in the lattice were studied for an impurity–metal couple. The hyperfine field of ^{175}Lu ions (radioactive daughter product of ^{175}Yb) implanted in Fe was measured at room temperature (Fe–Yb alloy). The hyperfine field of ^{175}Lu ions implanted in Ni was also measured. The measurement of the hyperfine field of an Fe–Lu alloy as a function of the sample annealing temperature demonstrated the existence of a sharp drop in this field between 400 and 500°C. The position of Yb ions in the Fe lattice was studied by channeling, the path lengths and widths of the depth distributions being measured. The channeling intensity distribution measurements made for the Yb in the principal channeling directions (using a ^{12}C beam) enabled about half of the implanted ions to be localized. It is concluded that no Yb ion migration phenomena take place until a temperature of 450°C is reached. Between 450 and 520°C, the thermal energy involved is sufficient for interactions to take place between the Yb ions and the vacancy loops. The Yb ions thus precipitate in the vacancy loops, this precipitation leading to the cancellation of the hyperfine field. (France)

837 (KFK-1754) CALCULATION OF PHASE EQUILIBRIA IN TERNARY SYSTEMS URANIUM—TRANSITION METAL—NITROGEN. Holleck, H.; Ishii, T. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material und Festkoerperforschung). Feb 1973. 48p. (In German). Dep. NTIS (U.S. Sales Only) $4.50.

Using estimated interaction parameters and considering available experimental results, isothermal sections of the systems uranium–transition metal–nitrogen are calculated. The calculations are made under the assumption of a regular solution. A good agree-

ment is observed between the calculations and experimental results in many cases. (auth)

838 (LBL-1130) DIFFUSION OF LANTHANUM IN MOLTEN URANIUM. Hovingh, J. (California Univ., Berkeley. Lawrence Berkeley Lab.). Feb 1973. Contract W-7405-eng-48. 128p. Dep. NTIS $8.50.

Thesis.

The diffusion coefficient and saturation concentration of lanthanum in molten uranium was measured using a capillary-tube technique. Activated lanthanum was placed on top of a uranium ingot in a beryllia capillary tube. The capillary tube was heated to 1200°C, held at temperature for various diffusion times, and cooled. The lanthanum concentration was determined as a function of distance in the uranium from the lanthanum/uranium interface by counting the photons emitted by the decay of the activated lanthanum. The measured diffusion coefficient of lanthanum in molten uranium appears to be at least an order of magnitude less than predicted by theory. The measured saturation concentration of lanthanum in molten uranium appears to be several times higher than previously reported. The higher apparent saturation concentration may be caused by lanthanum seepage into a gap formed between the uranium ingot and the beryllia capillary tube during heating. (31 references, 52 figures) (auth)

839 (NEL-537) EFFECT OF SURFACE CONDITIONS ON THE TENSILE BEHAVIOUR OF BERYLLIUM UNDER HYDROSTATIC PRESSURE. Pugh, H. L. D.; Chandler, E. F. (National Engineering Lab., Glasgow (Scotland)). Feb. 1973. 22p. Dep. NTIS (U. S. Sales Only) $3.25.

An examination was made of the effects of different surface finishes, and of sheathing the specimens by dipping in a mixture of latex rubber solution and ethyl methyl ketone, on the tensile properties of cast and extruded beryllium and hot-pressed powder beryllium when tested under a hydrostatic pressure of 7.72 kbar. It is shown that the major factor controlling ductility is not surface finish but surface sheathing. (auth)

840 (ORNL-TM-4071) ELASTIC-PLASTIC THICK-WALLED HOLLOW CYLINDER ANALOGY FOR ANALYZING THE STRAINS IN THE PLASTIC ZONE JUST AHEAD OF A NOTCH TIP. Merkle, J. G. (Oak Ridge National Lab., Tenn.). Jan 1973. Contract W-7405-eng-26. 83p. (CONF-710850-1). Dep. NTIS.

The fact that the plastic slip lines in the region just ahead of a circular notch tip are orthogonal logarithmic spirals indicates that in this region the principal directions of stress and strain are radial and circumferential. On the plane of symmetry just ahead of a notch tip, both the equation of radial equilibrium and the strain-displacement equations are identical to those for a thick-walled hollow cylinder under axisymmetric loading. Existing elastic-plastic thick-walled hollow cylinder solutions can thus be used to analyze the near-tip region of a notch, considering the effects of both strain hardening and transverse restraint. Calculations can be made to estimate the plastic zone size in plane strain, and to show the influence of root radius, yield stress, strain hardening and transverse restraint on fracture toughness. Example calculations are made for an H-11 steel, and for the A533 Grade B Class 1 steel being used as test material by the HSST Program. (auth)

841 (RD/B/M-2479) THERMODYNAMIC AND TRANSPORT PROPERTIES OF LIQUID SODIUM. Durham, M. E. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Nov 1972. 24p. (CFR/THWP/P-(72)28). Dep. NTIS (U. S. Sales Only) $3.25.

The thermodynamic and transport properties of saturated liquid sodium are presented in graphical form. Analytic expressions are also given from which the value of the particular property may be found as a function of temperature. S.I. units are used throughout. The properties of the sub-cooled liquid can be assumed equal to those of the saturated liquid at the same temperature, with negligible error. Conversion factors are given that enable the data to be expressed in imperial and c.g.s. units. (auth)

842 (RDT-M-2-15-T(4-73)) NICKEL-CHROMIUM ALLOY BARS, FORGINGS, AND FORGING STOCK (ASME SA-637 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Apr 1973. 11p. RSO.

A standard prescribing requirements for nickel-chromium alloy bars, forgings, and forging stock (ASME-SA-637) with additional requirements for nuclear and associated applications is presented. This standard supersedes RDT M 2-15T, dated October 1971. (JRD)

843 (RDT-M-6-6-T(4-73)) HIGH-STRENGTH, HIGH TEMPERATURE BOLTING MATERIALS (ASME SA-453 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Apr 1973. 9p. RSO.

A standard prescribing requirements for high-strength high-temperature bolting materials (ASME SA-453 with additional requirements) for nuclear and associated applications is presented. This standard supersedes RDT M6-6T, dated April 1972. (JRD)

844 (RFP-1950) EFFECT OF ALLOY CONTENT, CARBON, OXYGEN, AND NITROGEN ON THE MECHANICAL PROPERTIES OF URANIUM—2.2 WT. % NIOBIUM AND URANIUM—0.75 wt. % TITANIUM WROUGHT HEAT TREATED ALLOYS. Avery, J. G. (Dow Chemical U.S.A., Golden, Colo. Rocky Flats Div.). 1 Mar 1973. Contract AT(29-1)-1106. 10p. Dep. NTIS $3.00.

A series of uranium-niobium alloys was prepared with 1.8 wt % niobium composition and varying amounts of carbon, oxygen, and nitrogen. A similar series of uranium-titanium alloys was also prepared with the titanium content both above and below the desired 0.75 wt % level. The final chemical compositions of the various alloys were related to their heat-treated mechanical properties. It was found that carbon was detrimental to ductility in both uranium-niobium and uranium-titanium alloys, but did not affect the yield or ultimate strengths. In the uranium-titanium alloy, variations in titanium content affect the yield and ultimate strengths. The uranium-titanium alloy exhibited a "gettering" action in which part of the carbon was removed by titanium. (auth)

845 (UCID-16224) DYNAMIC EQUATION OF STATE OF MULBERRY ALLOY (PRELIMINARY). Kusubov, A. (California Univ., Livermore. Lawrence Livermore Lab.). 28 Jun 1967. Contract W-7405-eng-48. 10p. Dep. NTIS $3.00.

A table summarizes preliminary results from an experimental investigation of the equation of state of mulberry alloy and includes experimental results reported previously. The pressure range included is the 14 kbar to 1,879 Mbar, but inasmuch as the limited data between 80 and 200 kbar could not be readily interpreted, an accelerated program to obtain additional data in this range was initiated. (LMT)

846 (WHAN-D-3) STANDARD FFTF VALUES FOR THE PHYSICAL AND THERMOPHYSICAL PROPERTIES OF SODIUM. Yunker, W. H. (WADCO Corp., Richland, Wash.). 6 Jul 1970. Contract AT(45-1)-2170. 51p. Dep. NTIS $4.75.

The expressions given are based on and generally in agreement with recommendations of the Liquid Metal Information Center. In most cases an analytical expression and a graph of each property is given in engineering units. (JRD)

847 AXIAL RATIO AND PHASE CHANGES OF In-Tl ALLOYS DOPED WITH Cd AND/OR Sn. Matsuo, Y. (Nara Women's Univ., Japan); Katada, K. Acta Met.; 21: No. 6, 829-834(Jun 1973).

The lattice parameters and the axial ratios of fct In-rich In-Tl alloys doped with given amounts of Cd and/or Sn were measured by x-ray diffractometry. The axial ratio in each series of the doped system decreases gradually with increasing Tl content and discontinuously to unity at the concentration of Tl characteristic of the kind and the amount of doped element. This behavior is quantitatively analyzed by the pseudo-potential method. An additional energy due to short-range interactions is necessarily introduced in order to reach a successful interpretation of the observed trends and of the instability of fcc In with respect to tetragonal distortion. (auth)

848 ELASTIC CONSTANTS OF VANADIUM-IRON ALLOYS. Donegan, J. J. Jr.; Neighbours, J. R. (Naval Postgraduate School, Monterey, CA). Acta Met.; 21: No. 6, 821-828(Jun 1973).

Polycrystalline alloys of iron in vanadium up to 15.32 at. % were prepared principally by arc melting. Longitudinal and shear ultrasonic measurements in the range 10 to 30 MHz were made at room temperature. The resulting longitudinal modulus increased with alloying, whereas the shear modulus remained roughly constant although the data are somewhat scattered. These data are interpreted to show that the shear constants vary through alloying in a manner consistent with the results of other experiments and that the results are consistent with a s^1d^{n+1} electronic configuration in the transition metals. The existence of an isotropic alloy is indicated for alloys with electron to atom ratios lower than vanadium rather than for the alloys measured. (auth)

849 PLASTICITY OF NIOBIUM AND NIOBIUM-MOLYBDENUM SINGLE CRYSTALS IN THE SUPERCONDUCTING AND NORMAL STATES. Kostorz, G. (Institut Max von Laue-Paul Langevin, Grenoble, France). Acta Met.; 21: No. 6, 813-820(Jun 1973).

Single crystals of niobium and niobium-molybdenum (1.2 to 7.6 at. % Mo), all of the same orientation suitable for single slip on (101)[111], were annealed in an ultrahigh vacuum, and tensile tests at 4.2°K were performed after a small prestrain at room

temperature and 77°K. By the combination of ultrahigh vacuum purification and deformation at higher temperatures, stable plastic flow was possible at 4.2°K. During a constant strain rate test at 4.2°K, the superconducting and normal states were established alternately. The flow-stress change $\Delta\tau_{SN}$ at the transition was studied as a function of strain, strain rate, and alloy concentration. In all cases, $\Delta\tau_{SN}$ decreases as the strain increases. For pure niobium, $\Delta\tau_{SN}$ is independent of strain rate. Molybdenum solutes increase $\Delta\tau_{SN}$. The flow-stress change is discussed in terms of the different electronic drag coefficients in the two states and the stress and state dependence of the kink nucleation. (auth)

850 THERMODYNAMIC PROPERTIES OF COMPOUNDS IN THE INDIUM–BISMUTH SYSTEM. Boom, R.; Vendel, P. C. M.; De Boer, F. R. (Univ., Amsterdam). Acta Met.; 21: No. 6, 807-812(Jun 1973).

Heats of formation at 273°K of the compounds InBi, In_5Bi_3, and In_2Bi were determined to be −711 ± 60, −405 ± 54, and −109 ± 55 cal/g-atom, respectively, by means of liquid tin solution calorimetry. Comparison with earlier measurements and evaluations is made and some conclusions about the relative stability of the compounds are formulated. Heats of solution at infinite dilution of indium, bismuth, and silver in tin at 587°K are presented (−124 ± 21, 130 ± 47, and 3637 ± 24 cal/g-atom, respectively). (auth)

851 TEMPERATURE DEPENDENCE OF THE NORMAL MODES OF NIOBIUM. Powell, B. M.; Woods, A. D. B.; Martel, P. (Atomic Energy of Canada Ltd., Chalk River, Ont.). pp 43-52 of Neutron Inelastic Scattering, 1972. Vienna; International Atomic Energy Agency (1972).

From 5th IAEA symposium on neutron inelastic scattering; Grenoble, France (6 Mar 1972). See STI/Pub-308; CONF-720304-.

The frequencies of some normal modes of vibration propagating along the high-symmetry directions in niobium were measured at various temperatures from 296 to 1050°K. The changes in the general level of phonon frequencies are small in this temperature range, of the order of a few percent. The frequency of the mode H_{15} at 296 and 1050°K is 6.48 ± 0.08 and 6.32 ± 0.12 THz, respectively, while that of the mode P_4 is 5.03 ± 0.06 and 4.88 ± 0.07 THz. For particular modes however, e.g., the low-frequency modes of the [00ξ] T branch, the changes can be as large as 20% and even have a positive temperature coefficient. The changes in shape of the various branches result in the dispersion relation more nearly resembling that of a simple bcc metal at the higher temperatures. Detailed measurements were made at 1050°K of the [00ξ] T branch and of the Kohn anomaly on the [ξξξ] L branch. For the [00ξ] T branch the anomalous upward curvature at small wave vectors at 296°K becomes much less pronounced at 1050°K. This is reflected in the decrease in magnitude of the higher Fourier components and hence the long-range forces. A similar but less dramatic effect is observed on the [ξξξ] T and [ξξ0] T_2 branches. The pronounced Kohn anomaly on the [ξξξ] L branch has become much weaker at 700°K and has virtually disappeared at 1050°K. This effect again implies a decrease in magnitude of the long-range forces in niobium. (auth)

852 MAGNETIC EXCITONS IN $\Gamma_1-\Gamma_4$ SINGLET GROUND-STATE SYSTEMS. Birgeneau, R. J. (Danish Atomic Energy Commission, Risoe); Als-Nielsen, J.; Bucher, E. pp 543-551 of Neutron Inelastic Scattering, 1972. Vienna; International Atomic Energy Agency (1972).

From 5th IAEA symposium on neutron inelastic scattering; Grenoble, France (6 Mar 1972). See STI/PUB-308; CONF-720304-.

Measurements of the dispersion of singlet–triplet magnetic excitons as a function of temperature in the single ground-state ferromagnets fcc Pr and Pr_3Tl and in the paramagnetic alloy $(Pr_{0.88}La_{0.12})_3Tl$ are reported. Well-defined excitons are observed in both the ferromagnetic and paramagnetic regions, but with energies that are nearly temperature-independent, in disagreement with existing theory. (auth)

853 ANISOTROPIC COUPLING BETWEEN MAGNETIC IONS IN TERBIUM. Bjerrum Moeller, H.; Houmann, J. G.; Jensen, J.; MacKintosh, A. R. (Danish Atomic Energy Commission, Risoe). pp 603-610 of Neutron Inelastic Scattering, 1972. Vienna; International Atomic Energy Agency (1972).

From 5th IAEA symposium on neutron inelastic scattering; Grenoble, France (6 Mar 1972). See STI/PUB-308; CONF-720304-.

The magnon energies in the c direction of Tb have been studied as a function of magnetic field applied in the easy and hard directions in the basal plane. From the results, the components of the anisotropic two-ion coupling between the moments have been deduced as a function of $\vec{q}$. There is a very large anisotropy between the hexagonal axis and the basal plane which persists as the temperature is increased, and a smaller anisotropy in the plane which decreases with increasing temperature. It is tentatively suggested that the anisotropy in the two-ion coupling is primarily magnetoelastic in origin. (auth)

854 ELEVATED-TEMPERATURE PLASTIC FLOW OF HIGH-PURITY URANIUM IN THE ALPHA, BETA, AND GAMMA PHASES. Robinson, S. L. (Stanford Univ., CA); Sherby, O. D.; Armstrong, P. E. J. Nucl. Mater.; 46: No. 3, 293-302(Apr 1973).

The high-temperature mechanical properties of high purity α-, β-, and γ-uranium were investigated by compression testing, from which steady-state creep parameters were obtained. Stress exponents of 6 and 4.2 were obtained for α- and β-uranium respectively, while a varying stress exponent was found for γ-uranium which increases from 5 to about 7 with decreasing stress. For α- and γ-uranium, the activation energies for creep, after suitable correction for the temperature dependence of the elastic modulus (a very large correction of 20 kcal for α-uranium), were found to correspond closely to measured values of the volume self-diffusion activation energy. It is concluded, therefore, that creep of α- and γ-uranium is diffusion-controlled. The creep of β-uranium could not be concluded to be diffusion-controlled, since the creep activation energy was found to be significantly greater than the self-diffusion activation energy. When the creep data are plotted as diffusion-compensated creep rate versus modulus-compensated stress, the creep of α- and γ-uranium are seen to superimpose. This is significant since a six-fold ratio of elastic modulus exists between the two phases, and self-diffusion in γ is anomalously rapid with a low activation energy. When compared at the same value of $\dot{\epsilon}/D$, β-uranium is seen to be about 3 times stronger on a σ/E basis than α- and γ-uranium. (auth)

855 LORENZ NUMBER AND THERMAL CONDUCTIVITY OF LIQUID Hg–In. Busch, G.; Guentherodt, H. J.; Haller, W.; Wyssmann, P. (Eidgenoessische Technische Hochschule, Zurich). Phys. Lett., 43A: No. 3, 225-226(12 Mar 1973).

The Lorenz number of liquid Hg–Ln alloys has been carefully measured by using a modified Kohlrausch method. Temperature and concentration independent values are in good agreement with the free-electron Lorenz number. The thermal conductivity of liquid Hg–In alloys has been calculated from measurements of the Lorenz number and the electrical conductivity. (auth)

856 KONDO EFFECT IN RARE-EARTH ALLOYS: ROLE OF THE CRYSTAL FIELD. Borchi, E.; De Gennaro, S. (Univ., Florence). Phys. Lett.; 43A: No. 3, 234-236(12 Mar 1973).

From the s–f exchange model an examination was made of the influence of the crystal-field on the magnetic resistivity of a Kondo system. By taking into account crystal-field splitting of the localized levels, the Kondo effect in rare-earth alloys with a value of the coupling constant $J_{sf} < 0$, as it is usually required for transition-metal alloys, can be explained. (auth)

857 INTEGRATED QUASI-ELASTIC NEUTRON SCATTERING INTENSITY OF HYDROGEN IN NIOBIUM. Gissler, W.; Jay, B.; Rubin, R.; Vinhas, L. A. (EURATOM–CCR, Ispra, Italy). Phys. Lett.; 43A: No. 3, 279-281(12 Mar 1973).

The integrated quasi-elastic neutron-scattering intensity of $NbH_{0.13}$ was measured at 235°C over a large momentum transfer range ($0.6 < K < 4$ Å^{-1}). In the high-temperature phase a deviation from a simple Debye–Waller factor governed intensity dependence was observed. (auth)

858 IMPLICATIONS OF NEW DATA ON THE HEAT CAPACITY OF TUNGSTEN FOR THE POWDERED CERIUM MAGNESIUM NITRATE TEMPERATURE SCALE. Phillips, N. E.; Thorp, T. L.; Triplett, B. B. (Univ. of California, Berkeley). Phys. Lett.; 43A: No. 3, 285-286(12 Mar 1973).

The tungsten critical field data obtained by Black, Johnson, and Wheatley (J. Low Temp. Phys., 1: 641(1969)) on the CMN temperature scale are reanalyzed, using a new value of γ. The analysis requires $\Delta \neq 0$ at $T \leq 4.5$ mK, and positive temperature-independent values of Δ are ruled out. (auth)

859 EFFECT OF SPECIMEN THICKNESS ON THE FRACTURE TOUGHNESS OF Ti–6 Al–4 V. Galda, K. H.; Munz, D. (Institut fuer Werkstoff-Forschung, Porz-Wahn, Ger.). Int. J. Fracture Mech.; 8: No. 4, 472-474(Dec 1972).

The thickness B was varied from 2 to 14 mm, and the K_Q value was determined by the 5% secant method. The average K_Q ($= K_{Ic}$) for B = 14 and 10 mm is ~39 MN/m$^{3/2}$ (44 ksi $\sqrt{in}$); for smaller B, it increases. The K_c at the onset of crack extension is ~0.75 K_Q for $B > 8$ mm; below 8 mm, K_c increases like K_Q. The yield stress is 1015 MN/m^2 (72 ksi), leading to a critical thickness B_c = 3.7 mm; thus, the factor 2.5 should be replaced by 5, and below B_c no pure plane strain state exists in the center of the specimen. (DLC)

860 RELATIONS BETWEEN THE MORPHOLOGICAL AND CRYSTALLOGRAPHIC CHARACTERISTICS OF INTERGRANULAR PRECIPITATION REACTIONS. Giraud-Heraud, F. (Societe Industrielle de Combustible Nucleaire, Veurey, France); Guillaume, C. Mem. Sci. Rev. Met.; 69: No. 10, 717-726(Oct 1972). (In French).

Intergranular precipitation reactions in uranium alloys are dis-

cussed. Both the continuous and the discontinuous cases are considered for supersaturated solid solutions. The results demonstrate that the weakly disoriented grain boundaries and the semicoherent interphases favor the formation of oriented precipitates and the highly disoriented grain boundaries and the disordered interphases favor the formation of allotriomorphic crystals and cellular structures. (FR)

861 MAGNETIC SUSCEPTIBILITY OF POLYCRYSTALLINE AND SINGLE CRYSTAL HOLMIUM FROM 293 TO 873°K. St. Quinton, J. M. P. (Univ. of Malaya, Kuala Lumpur). J. Phys., F (London); 3: No. 3, 597-603(Mar 1973).

Measurements of the magnetic susceptibilities of polycrystalline and single crystal holmium in the temperature range 293 to 873°K are reported. Departures from Curie-Weiss behavior are found below 473°K. Above 473°K, the $1/\chi$ against T curves are linear to experimental accuracy and give values for the effective magneton number within 0.3% of the free ion value 10.61. The range below 473°K would lead to higher values for the moment. Anisotropy in single crystal holmium persists to the highest temperature reached (873°K) and is consistent with the known behavior at lower temperatures. The difference between the paramagnetic Curie points of the two single crystal components, $\Delta\theta = \theta_{||} - \theta_{\perp}$, is deduced from the value of $1/\chi_{||} - 1/\chi_{\perp}$ at a particular temperature. The value $\Delta\theta = -13.7 \pm 0.2$ K is found at 293°K, and $\Delta\theta$ shows a tendency to reduce slowly in magnitude with increasing temperature. (auth)

862 VARIATION OF EFFECTIVE AND INTERNAL STRESSES DURING CYCLIC STRAINING IN α-ZIRCONIUM. Miura, S.; Umeda, K. (Doshisha Univ., Kyoto). Scr. Met.; 7: No. 4, 337-344(Apr 1973).

Polycrystals of 99.79% pure α-Zr were cyclically strained at constant total strain amplitude (0.5, 1.5, 3.0, and 5.0%). Single-strain-rate cycling tests were performed on the hysteresis loop at each cycle. Cyclic strain hardening was observed during the first ten cycles for all amplitudes, but not thereafter. An increase in activation volume results on cyclic straining, and this effect is greater for the smaller amplitudes. Peak, effective, and internal stresses and their ratio were measured and are plotted versus cumulative plastic strain. Results indicate that the mobile dislocation density increases during the cyclic straining, and that the effective stress decreases and the internal stress increases with the number of cycles. (DLC)

863 DYNAMIC STRAIN AGING IN ZIRCALOY AND ITS DEPENDENCE ON COLD WORK, RECRYSTALLIZATION, AND GRAIN SIZE. Kaellstroem, K.; Svenzon, M. (Sandvik Aktiebolag, Sandviken, Sweden). Scand. J. Met.; 2: No. 1, 55-58(1973).

The strain rate sensitivity (SRS) in Zircaloy-2 was investigated by means of strain rate changes during hot tensile testing in the range 200 to 600°C. There was a pronounced minimum SRS at around 400°C, accompanied by plateaus in the strength vs temperature relationships, by a ductility minimum, and by a strain hardening maximum. These are effects of dynamic strain aging originating from dissolved elements interacting with dislocations. The SRS minimum is associated with rapid generation of new dislocations at sources operating at a stress level more or less independent of the strain rate. The prime purpose of the work was to control the mechanical properties, and specially the 300 to 400°C creep strength, by the optimization of production parameters to derive maximum benefit from strain aging. It was found that cold work lowered the temperature of minimum SRS. This was reversed gradually as the degree of recrystallization was increased by annealing. Also, coarser recrystallized grain size gave a higher temperature of minimum SRS. Lowering the strain rate by a factor of 10 lowered the temperature of minimum SRS by 20°C. Extrapolation to creep rates indicates maximum effect at 280 to 350°C. (auth)

864 DISPERSION RELATIONS IN SOME HEXAGONAL METALS. Upadhyaya, J. C.; Verma, M. P. (Agra Coll., India). J. Phys., F (London); 3: No. 3, 640-646(Mar 1973).

Results are reported of calculations on the dispersion relations of four hcp metals Be, Mg, Ho, and Tl based on a model in which the interaction system consists of seven neighbor central forces and a corrected electron-ion interaction. Agreements with experimental measurement are fairly good in two cases, namely Be and Mg, but not so good in the other two. However the dispersion curves in the [0001] direction are obtained in almost exact agreement with the experimental ones and the deviations that are largest at the zone boundaries in the [01$\bar{1}$0] direction are, in general, not more than 15%. (UK)

865 ELECTROSLAG WELDING OF A MARTENSITIC-AUSTENITIC FERRITIC STAINLESS STEEL. Groenwall, B. (Aktiebolaget Atomenergi, Studsvik, Sweden). Scand. J. Met.; 1: No. 4, 171-178(1972).

The weldability of Avesta 248 SV steel during the electroslag welding process was studied using a plate of 100-mm thickness and a range of energy inputs. The main effort of the investigations was directed towards clarifying the complex microstructures and mechanical properties of the weld metal and of the heat-affected zone. No defects could be detected in the welded joints using radiographic or ultrasonic test techniques. Microscopic examination of specimens cut from different parts of the joints also failed to reveal defects. Heat treatment subsequent to welding included either tempering (stress relieving) alone or hardening and tempering. After tempering, the properties of the welded joint were as good as those of the parent steel in the hot-rolled and tempered condition. Hardening and tempering increased the yield strength to a greater extent in the parent plate than in the weld metal. Material in the superheated region of the transformed heat affected zone was, after tempering, equivalent in every respect to the parent plate after hardening and tempering. For this grade of steel, tempering is a satisfactory method of heat treatment following electroslag welding. (auth)

866 INTERPRETATION OF THE AUGER SPECTRUM OF CLEAN AND OXIDIZED Be. Suleman, M.; Pattinson, E. B. (Univ. of Keele, Eng.). J. Phys., F (London); 3: No. 3, 497-504 (Mar 1973).

The Auger electron spectrum of a clean Be surface has been investigated. The changes in the spectrum due to oxidation of the surface have also been observed. A possible interpretation of the oxidized spectrum has been offered, based on the changes in the valence band and the shift in the K level of Be on oxidation. (auth)

867 LATTICE DISTORTION PRODUCED BY VACANCIES IN IRON, MOLYBDENUM, AND VANADIUM. Kenny, P. N.; Trott, A. J.; Heald, P. T. (Surrey Univ., Guildford, Eng.). J. Phys., F (London); 3: No. 3, 513-522(Mar 1973).

The lattice distortion produced by an isolated vacancy in bcc metals, iron, molybdenum and vanadium was calculated using a discrete-lattice model. In addition, the interaction energies between pairs of vacancies in these metals were computed as a function of their separation. The lattice model assumes a non-equilibrium central potential that includes interactions out to second-nearest neighbors and the calculations are performed in reciprocal space. The asymptotic displacement fields were compared with the corresponding elasticity results for molybdenum and vanadium. (auth)

868 STRUCTURAL PARAMETERS AND UNIT CELL DIMENSIONS FOR THE TETRAGONAL ACTINIDE TETRACHLORIDES (Th, Pa, U, AND Np) AND TETRABROMIDES (Th AND Pa). Brown, D.; Hall, T. L.; Moseley, P. T. (Atomic Energy Research Establishment, Harwell, Eng.). J. Chem. Soc., Dalton Trans.; No. 6, 686-691(1973).

Comparison of crystal structure parameters obtained for $ThCl_4$ from quantitative x-ray powder data with those available from single-crystal studies has shown that it is possible to obtain reliable parameters from powder studies on simple compounds. Structure refinement based on powder data for $ThCl_4$ (R = 8.9%), $PaCl_4$ (R = 7.6%), UCl_4 (R = 9.5%), $NpCl_4$ (R = 9.1%), and $ThBr_4$ (R = 11.3%) has yielded crystal structure parameters, and bond lengths for these isostructural compounds. Accurate unit cell dimensions are also reported. (auth)

869 INFLUENCE OF THE THERMAL MOTION OF ATOMS IN A SOLID ON THE NEUTRON SCATTERING. Kalus, J. (Institut Max von Laue-Paul Langevin, Grenoble, France). Ann. Phys. (Paris); 7: No. 4, 247-254(Jul 1972).

Elastic and inelastic scattering of neutrons by a crystal is discussed in terms of the harmonic approximation. The problem of self-diffusion in a solid is also discussed. (France)

870 ELASTIC PROPERTIES OF MOLYBDENUM. Reiter, W.; Benesovsky, F. Planseeber. Pulvermet.; 20: No. 3, 203-218 (Sep 1972). (In German).

The elastic and shear moduli and Poisson's ratio on compression test specimens of Mo after 32, 58, and 70% reduction by swaging at 1100°C were determined. The effect of work hardening in reducing the moduli is considered in relation to possible mechanisms. (19 references) (Metals Abstr.)

871 PHYSICAL PROPERTIES OF URANIUM-ZIRCONIUM ALLOYS AT LOW TEMPERATURES. Fedorov, G. B.; Zuev, M. T.; Smirnov, E. A.; Kissil, A. E. At. Energ. (USSR); 34: No. 2, 85-88(Feb 1973). (In Russian).

The physical properties (resistivity, integral thermoelectrical moving forces, internal friction, and modulus of elasticity of annealed uranium-zirconium alloys were investigated. The resistivity was measured at temperatures of 295, 77.4, and 4.2°K; the other properties were measured in the temperature interval from that of liquid nitrogen to room temperature. The maximum resis-

tivity and thermal emf, as well as an anomalous (negative) resistivity temperature coefficient, were observed in the composition range corresponding to the δ_1 phase. On the basis of the obtained results and previously published data, the authors conclude that there exists a hybrid-type metallic-covalent chemical bond in the δ_1 phase of uranium–zirconium alloys. (auth)

872 PHASE STRUCTURE OF NIOBIUM ALLOYS OF THE NIOBIUM–TUNGSTEN–ZIRCONIUM–CARBON SYSTEM. Savitskii, E. M.; Ivanova, K. N. At. Energ. (USSR); 34: No. 2, 89-92 (Feb 1973). (In Russian).

Niobium-rich alloys of the niobium–tungsten–zirconium–carbon system, containing up to 4 at. % zirconium, up to 2 at. % carbon and a constant 10 at. % (18 wt %) tungsten, have been investigated by means of metallographic and x-ray analysis. The hardness and microhardness of these alloys have been measured. The isothermal section of the indicated portion of the niobium–tungsten–zirconium–carbon system at 1800°C has been plotted. At this temperature in equilibrium with quaternary niobium solid solution the following phases have been found: hexagonal Nb_2C, fcc(Zr,Nb,W)C, and the chemical compound W_2Zr (Laves phase with fcc structure of the $MgCu_2$ type). In the investigated alloys, the solid solubility of carbon at 1800°C decreases from 0.5 to 0.2 at. % when 1 to 4 at. % zirconium is introduced. The concentration regions of ductility have been established for the investigated alloys. The phases found in the niobium–tungsten–zirconium–carbon system can be used to effectively strengthen the material, especially in conjunction with appropriate heat treatment. (auth)

873 INDIUM AND INDIUM ALLOY DEPOSITION. Addition Agents in Sulfate, Sulfamate, and EDTA Baths. Indira, K. S.; Udupa, H. V. K. (CECRI, Karaikudi, India). Metal Finish.; 70: No. 4, 57-61(1972).

The effects of quaternary ammonium compounds as addition agents are determined. The conditions for obtaining smooth, bright, adherent, coherent deposits, and the effect of both composition and operating variables on the nature of the deposits obtained are reported. (Indian Sci. Abstr.)

874 SOLID + LIQUID PHASE EQUILIBRIA IN THE TERNARY ALLOY: SODIUM + POTASSIUM + RUBIDIUM. Ott, J. B.; Goates, J. R.; Hsu, C. C. (Brigham Young Univ., Provo, UT). J. Chem. Thermodyn.; 5: No. 1, 143-145(Jan 1973).

Thermal methods were used to determine solid + liquid phase equilibria for the ternary alloy; sodium + potassium + rubidium. The lowest temperature at which liquid can exist is 255°K, which is only 5°K lower than the Na + K eutectic. (auth)

875 PHONON DISPERSION IN SCANDIUM. Bose, G.; Gupta, H. C.; Tripathi, B. B. (Indian Inst. of Tech., New Delhi). Phys. Lett.; 43A: No. 4, 365-366(26 Mar 1973).

With the electron–ion interaction models, the phonon dispersion of hcp Sc was obtained by solving the secular determinant along the symmetry directions [0001] and [0110]. The calculated phonon frequencies are in agreement with neutron inelastic scattering data except at some points, especially at the zone boundary along the [0110] direction. The overall agreement is better for the Clark, Gazis, and Wallis model than for the de-Launey model. (DLC)

876 WORK FUNCTION OF PRINCIPAL FACES OF SINGLE CRYSTALS OF SOLID SOLUTIONS OF RHENIUM IN MOLYBDENUM. Smirnova, N. B. (Tashkent State Univ.). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 6, 65-66(1972). (In Russian).

The work functions of the main faces of alloy single crystals containing Mo–12.5% Re and Mo–42% Re were measured in a vacuum of 10^{-8} torr. The work functions for faces (110) and (100) agreed with those for the corresponding faces of pure Mo. (KSW)

877 SIGNIFICANT LIQUID STRUCTURE THEORY APPLIED TO THE CRITICAL PROPERTIES OF THE ALKALI METALS. Hsu, C. C.; MacKnight, A. K.; Eyring, H. (Univ. of Utah, Salt Lake City). J. Inorg. Nucl. Chem.; 35: No. 1, 45-51(Jan 1973).

The significant liquid structure theory has been used to estimate the critical properties of the alkali metals. The argon partition function is used at the critical point and the equilibrium between the monomer and the dimer of the alkali metals is considered. It is found that the compressibility coefficient $P_cV_c/(RT_c)$ of the alkali metals at the critical point varies about the value 0.40. Calculations indicate that there are about 70% of gas-like degrees of freedom at the critical point compared with less than 2.5% at the melting point of the alkali metals. The calculated results are compared with various estimated values and with the available experimental data. (auth)

878 STRAIN-RATE SENSITIVITY AND YIELD STRESS OF Fe–Mo, Fe–Ti, and Fe–Re SOLID SOLUTIONS. Leemans, D. Evanston, IL; Northwestern Univ. (1972). 101p. University Microfilms Order No. 73-10,252.

Thesis (Ph. D.).

The effect of alloying on the plastic deformation of polycrystalline iron was investigated in the temperature range 77 to 296°K for three alloy systems. Solid solutions of Fe–Mo, Fe–Ti and Fe–Re were tested in tension, and yield stress and strain-rate sensitivity were measured. Fe–Mo and Fe–Re alloys were annealed in wet H_2 and had a lower impurity concentration than the vacuum annealed Fe–Ti alloys. Important observations in this study are summarized as follows: (a) Titanium causes a softening effect on the yield stress at 273°K and 296°K up to about 0.15 at. %. No softening is observed at those temperatures in Fe–Mo and Fe–Re alloys. (b) At 166°K and 196°K the concentration dependence of the yield stress is identical in the three systems. An initial increase in the yield stress is observed by alloying. This is followed by a softening effect in an intermediate concentration range. (c) The strain rate sensitivity versus temperature curves shift to lower temperatures with increasing concentration. This was observed for the three investigated systems. The data at room temperature indicate that impurities play an important role at this temperature and the softening can be explained adequately by a scavenging theory, i.e., the titanium solute atoms remove mobile impurity atoms from solution. (LMT)

879 CHARACTERISTICS OF WELDED BERYLLIUM–COPPER ALLOYS. Goldstein, S. CDA-ASM Conference Paper No. 052/2. New York; Copper Development Association, Inc. (1972). 28p.

A description is presented of the mechanical properties and characteristics of welds and adjacent base metal in CA 172 and CA 175 in a wide range of conditions. Electrical conductivity across welded joints in the Be–Cu alloys in various heat-treated conditions is listed. One application of a Be–Cu weldment is a submarine cable repeater used in long-distance ocean cable systems. (Metals Abstr.)

880 MANUFACTURE; PROPERTIES, AND APPLICATIONS OF HIGH-CONDUCTIVITY HIGH-STRENGTH Cu–ThO_2. Scheithauer, W. Jr; Cheney, R. F.; Kopatz, N. E. CDA-ASM Conference Paper No. 011/2. New York; Copper Development Association, Inc. (1972). 14p.

Methods are described for producing plate, sheet, rod and wire of high-purity Cu with dispersions of ThO_2 particles. Densification, which cannot be accomplished by conventional sintering techniques, is done either by hot forging, hot rolling or hot extrusion. After the thermomechanical densification step, the material can be further worked into wrought forms by somewhat conventional techniques. High purity permits attainment of conductivities >95% IACS. With the best ThO_2 dispersions, 600°C yield strengths to 20,000 lb/in^2 are obtained with Cu–1ThO_2. Better dispersions should yield higher strengths. After annealing at 1000°C, the room-temperature 0.2% yield strengths were still as high as 20,000 to 25,000 lb/in.^{2} Cu–ThO_2 has about the same outgassing characteristics, better machining characteristics and about the same brazing characteristics as OFHC Cu. (Metals Abstr.)

881 IMMISCIBILITY IN BINARY ALLOYS OF GROUP 1A METALS (LITHIUM, SODIUM, AND POTASSIUM). Kumar, R. (National Metallurgical Lab., Jamshedpur, India). J. Mater. Sci.; 7: No. 12, 1426-1433(Dec 1972).

The miscibility syndrome is evaluated in order to predict the occurrence of miscibility gaps in the binary alloy systems of lithium, sodium, and potassium; and its predictions are compared with those from the Hildebrand, the Kumar–Hildebrand parameters or the concept of Mott number. It is shown that, statistically, the predictions from the miscibility syndrome are most reliable. An attempt is also made to partially rationalize the nature of the binary liquid systems in terms of the electronic configuration of the valency electrons. (auth)

882 PROBLEMS OF THERMOPLASTICITY. Perzyna, P.; Sawczuk, A. (Inst. of Fundamental Technological Research, Warsaw). Nucl. Eng. Des.; 24: No. 1, 1-55(Jan 1973).

The problems of irreversible deformation of metallic structures have come to the very focus of interest in nuclear reactor technology. Developments of the theory of thermoplasticity are surveyed. Starting with the notions of thermodynamics of continua a theory of rheological materials with internal changes implied by plastic deformations is presented. Both a general theory of elastic-viscoplastic materials and its experimental motivation are discussed. Thermoplastic relations at infinitesimal deformations are considered. Thermo-plastic boundary value problems are also considered. Solutions and methods of solution are discussed for problems of quenching, thermal shocks, internal heat generation, and machine parts design. Thermal cycling and combined thermomechanical loading are considered, methods of shakedown analysis being presented. An extensive bibliography is included. (auth)

883 QUANTUM THEORY OF ISOTOPE EFFECTS IN THE ELECTROMIGRATION AND THERMOMIGRATION OF LIGHT INTERSTITIALS. Stoneham, A. M.; Flynn, C. P. (Atomic Energy Research Establishment, Harwell, Eng.). J. Phys., F (London); 3: No. 3, 505-512(Mar 1973).

The electromigration and thermomigration of light interstitials, such as hydrogen in metals, have been examined in terms of the quantum theory of diffusion of Flynn and Stoneham (Phys. Rev., B1: 3966-78(1970)). The pronounced isotope effect observed in the effective charge Z^* is shown to come from the differences in the self-trapping distortions of the various isotopes. The qualitative dependence of Z^* on isotope, host lattice, and temperature are correctly predicted. The interstitial contribution to the reduced heat of transport Q^* is calculated directly from the quantum theory. There is no term proportional to the activation free energy in the regime of interest. The dominant contribution to Q^* is probably that from the electron gas, although the entropy of solution adds an important term. Again, the qualitative results are consistent with the sparse experimental data. (auth)

884 MOESSBAUER STUDY OF FeV AND FeCr ALLOYS. Nemoshkalenko, V. V.; Pazumov, O. N.; Nagornyi, V. Ya.; Tomashevskii, N. A. (Inst. of Metal Physics, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 17: No. 10, 1739-1741(Oct 1972). (In Russian).

The alloys Fe–47.7% V and Fe–45.0% Cr were prepared in an electric arc furnace under an Ar atmosphere. The ^{57}Fe Moessbauer spectra were determined for the α and σ phases of the two alloys, and the conditions for transition from one phase to the other were investigated. (KSW)

885 MAGNETIC ORDERING IN (La, Gd)Al_2 ALLOYS. Maple, M. B. (Univ. of California, La Jolla). Solid State Commun.; 12: No. 7, 653-656(1 Apr 1973).

The detailed dependence of the magnetic ordering temperature T on Gd concentration n below ~15 at. % Gd substitution for La is reported for the system (LaGd)Al_2. In this concentration range, the T vs n curve lies markedly below the extrapolation of the linear behavior previously observed for concentrations $\gtrsim$20 at.% Gd, and apparently goes to zero at a finite concentration. The effective moment of Gd is enhanced by 1 μ_B over the free ion value. (auth)

886 HYPERFINE SPECIFIC HEAT OF $HoCo_2$. Bloch, D. (CNRS, Meudon, France); Voiron, J.; Berton, A.; Chaussy, J. Solid State Commun.; 12: No. 7, 685-687(1 Apr 1973).

The specific heat of $HoCo_2$ was measured between 1.3 and 5°K, a temperature range in which the nuclear specific heat predominates. The magnetic moment of holmium determined from the data is $(10 \pm 0.2)\mu_B$. This value is compared with the values deduced from magnetization and elastic neutron scattering experiments. (auth)

887 OPTICAL PROPERTIES OF Nb_3Sn. A Probe of the Electronic Density of States. Pickett, W. E.; Allen, P. B. (State Univ. of New York, Stony Brook). Solid State Commun.; 12: No. 7, 677-680(1 Apr 1973).

An expression for the conductivity of an impure metal is derived in a simple manner in terms of a frequency-dependent relaxation time τ. This method involves perturbation theory and an $(\omega\tau)^{-1}$ expansion but is shown to agree with a rigorous treatment. The infrared absorptivity of the A15 material Nb_3Sn is calculated and it is found that optical properties will give direct information about the electronic density of states. (auth)

888 EFFECT OF LONG-RANGE ORDER ON LOW-TEMPERATURE DEFORMATION PROCESSES IN A PERMENDUR-TYPE ALLOY (Fe–47% Co–2% V). Koylu, Y. G. (Imperial Coll. of Science and Tech., London); Hancock, G. F.; Rawlings, R. D. Phys. Status Solidi (a); 16: No. 1, 73-80(16 Mar 1973).

The temperature dependence of the yield stress and the deformation mechanisms of an Fe–47% Co–2% V alloy was studied as a function of the degree of long-range order. Results suggest that the Peierls mechanism is the rate-controlling process for all conditions of the alloy below 250°K. Above this temperature, another thermally activated mechanism is operative for all conditions of the alloy other than the fully ordered. (8 figures, 35 references) (auth)

889 CRYSTAL STRUCTURE OF V_3Rh_5. Waterstrat, R. M.; Dickens, B. (National Bureau of Standards, Washington, DC). J. Less-Common Metals; 31: No. 1, 61-67(Apr 1973).

The unit cell is orthorhombic with a = 5.420 Å, b = 9.276 Å, c = 4.320 Å and Z = 2; the space group is either Cm2m or Cmcm. The structure is close-packed and contains both ordered and disordered atomic sites. It is intermediate between the structures of the Cu_3Au and CuAu types except that it possesses a two-layer stacking sequence. (auth)

890 MOESSBAUER STUDIES OF Fe–23 AT. % Be ALLOY AGED ABOVE 400°C. Yagisawa, K. (National Inst. for Metals, Tokyo). Phys. Status Solidi (a); 16: No. 1, 291-297(16 Mar 1973).

Moessbauer spectra were studied for a Fe–23 at.% Be alloy aged at various temperatures. The spectra were analyzed by computer to obtain information on beryllium concentrations, hyperfine fields in the matrix and the precipitate, and the volume fraction of precipitates. The Be concentrations in the matrices thus obtained are in reasonable agreement with those estimated from the lattice parameter measured by an x-ray method. The hyperfine field at Fe atoms in the matrix is found to decrease by about 13.1 kOe whenever its nearest neighbors of Fe atoms are replaced by a Be atom, and by about 6.6 kOe whenever its next nearest neighbors are replaced. The hyperfine field of the precipitate of the metastable phase formed in a specimen aged at 600°C coincides with that of the stable phase formed in a specimen aged at 650°C, suggesting that the crystal structure of the metastable phase is of $MgCu_2$-type. (20 references) (auth)

891 MAGNETIC BEHAVIOR OF ALLOYS OF PALLADIUM WITH GADOLINIUM, DYSPROSIUM, AND HOLMIUM. Loebich, O. Jr.; Raub, E. (Forschunginstitut fuer Edelmetalle und Metallchemie, Gmuend, Ger.). J. Less-Common Metals; 31: No. 1, 111-118(Apr 1973). (In German).

The magnetic susceptibilities of rare earth alloys in the composition range 0 to 100 at.% Pd were measured between 140 and 720°K. Results suggest that the gadolinium, dysprosium, and holmium ions exist in a trivalent state irrespective of the composition or structure in which they are incorporated. In the solid-solution range, the 4d shell of palladium is filled as the rare earth concentration is increased. (auth)

892 CONSTITUTION AND STRUCTURE OF SOME RARE EARTH–PLATINUM ALLOYS IN THE RANGE 20 TO 35% RARE EARTH. Harris, I. R. (Univ. of Birmingham, Eng.); Gardner, W. E.; Taylor, R. H. J. Less-Common Metals; 31: No. 1, 151-158(Apr 1973).

The range of stability of the Laves phase based on $GdPt_2$ was determined by lattice parameter measurements and results indicate that the $GdPt_2$ composition lies within the two-phase region. In the arc-melted condition, the alloy corresponding to $TbPt_3$ has the defect, C15-type structure but is converted to the $L1_2$-structure by annealing at 1173°K for two hours. $TbPt_3$ with these two structures exhibits markedly different magnetic susceptibility behavior at low temperatures. (auth)

893 PHASE RELATIONSHIPS AND MAGNETIC PROPERTIES OF URANIUM–GALLIUM COMPOUNDS. Buschow, K. H. J. (Philips Research Labs., Eindhoven, Netherlands). J. Less-Common Metals; 31: No. 1, 165-168(Apr 1973).

The U–Ga system was studied by x-ray diffraction, metallography, and thermal analysis over the whole concentration range. Three compounds were observed: U_2Ga_3, UGa_2, and UGa_3. A phase diagram was constructed. The lattice constants of the three observed compounds were determined. Magnetic properties of the compound U_2Ga_3 are reported. Its magnetic moment per U atom (1.1 μ_B) and its ferromagnetic transition point (19°K) are appreciably lower than those of the compound UGa_2. (auth)

894 EFFECT OF HIGH PRESSURE ON THE CRYSTAL STRUCTURE OF $LaOs_2$ AND $CeOs_2$. Cannon, J. F. (Brigham Young Univ., Provo, UT); Robertson, D. L.; Hall, H. T.; Lawson, A. C. J. Less-Common Metals; 31: No. 1, 174-176(Apr 1973).

The $MgCu_2$-type cubic compounds LOs_2 (L = La, Ce, Pr) were prepared and their lattice parameters measured. Experiments at 70 kbar and 1000°C resulted in the conversion of the cubic materials to the hexagonal form. Hexagonal $CeOs_2$ could be prepared at pressures as low as 6 kbar, and the lowest synthesis pressure for hexagonal $LaOs_2$ is between 6 and 14 kbar. Above 1050 to 1100°C, the cubic structure was retained regardless of the pressure. X-ray data are given for $LaOs_2$ and $CeOs_2$. Results show that the polymorphic transition point shifts toward the lighter lanthanides with high pressure at temperatures less than 1050 to 1100°C. (DLC)

895 STUDY OF THIN FILMS OF TANTALUM OXIDE BY THE METHOD OF THERMAL-STIMULATED CURRENTS. Seve, G.; Lassabatere, L. (Univ., Montpellier, France). Thin Solid Films; 15: No. 3, 285-301(Mar 1973). (In French).

Thermal currents were studied in a thin layer of Ta_2O_5 prepared by Thomson C.S.F. Corbeville. The experimental curves proved the existence of three peaks at energies 0.20, 0.53, and 0.82 eV, respectively. The second peak, of intermediate energy (0.53 eV), was isolated and a complete study made using the method of Cowell and Woods. Experimental results indicate that the relaxation mechanisms are characterized by a time constant of the form $\tau = \tau_0 \exp(E_t/kT)$. This behavior may be interpreted

by use of a model based on the dipolar polarization or a space-charge mechanism. Although these different mechanisms may be acting simultaneously, the dipolar relaxation seems to be the more probable and pronounced one. Using this hypothesis, moment, and density of dipoles were determined. (auth)

896 NEUTRON-DIFFRACTION STUDY OF U_3Se_4. Szytula, A. (Jagellonian Univ., Krakow); Suski, W. Acta Phys. Pol., A; A43: No. 4, 631-633(Apr 1973).

The neutronographic measurements on U_3Se_4 were carried out at the temperature range between 77°K and the room temperature. The results obtained at room temperature confirm the existence of the structure isomorphic to that of Th_3P_4. No magnetic ordering was observed at 77°K. (auth)

897 X-RAY DIFFRACTION EFFECTS IN THE CASE OF IMPLANTED SILICON SINGLE CRYSTALS. Auleytner, J. (Inst. of Physics, Warsaw); Furmanik, Z.; Godwod, K.; Krylow, J. Acta Phys. Pol., A; A43: No. 4, 507-512(Apr 1973).

The effects of x-ray diffraction by a layer of silicon implanted with a 10^{15} ions/cm^2 dose of 60-keV boron ions are studied. Use was made of the methods of x-ray automonochromatization by an oscillating slit and a two-crystals x-ray spectrometer. The reflectivity and lattice constant are found to be larger for the implanted layer, and the broadening of the diffraction curve by about three times for this layer shows that there are lattice defects in it. (auth)

898 CREEP DURING THE HOT PRESSING OF REFRACTORY METALS WITH ADDITION OF OXIDES. Samsonov, G. V. Phys. Sintering; 4: No. 3, 141-149(Sep 1972).

Analyses are given of the creep during hot-pressing in Nb, Mo, and W powders with and without the addition of oxides. The creep rate was dependent upon temperature and pressure applied. The activation energy for the process is represented by the sum of the vacancy-movement energy and the energy of steps. (Metals Abstr.)

899 TILTED HELIX: AN INTERMEDIATE MAGNETIC PHASE. Sherrington, D. (Imperial Coll. of Science and Tech., London). J. Phys., C (London); 6: No. 6, 1037-1053(28 Mar 1973).

In a system of localized spins interacting via an exchange favoring helical ordering, there is a region of forbidden axial anisotropy separating normal flat and conical spirals as the stable orders. The stable phase in the intermediate region is shown to be a titled helix corresponding to tilting the planes of a normal flat spiral together with additional perturbations of pitch and out-of-plane wobble. An investigation is presented of the ordering, stability, and excitation of this intermediate phase. It is proposed that the model provides an explanation of intermediate phases seen in Er–Tb, Er–Dy alloys and also Er metal itself. It is suggested that similar intermediate phases may exist in Ho and certain other alloys, although unconsidered magnetostrictive or other forces could lead to discontinuities which prevent their manifestation. (auth)

900 MAGNETIC STRUCTURES. Bertaut, E. F. (Centre National de la Recherche Scientifique, Grenoble, France). Ann. Phys. (Paris); 7: No. 4, 203-232(Jul 1972).

Emphasis is put on the properties required of the magnetics (variable position magnets) and the cryostats used to study critical phenomena (1- and 2-dimensional systems). An experiment is suggested for measuring the variation of the anisotropy constants K_1 and K_2 with temperature for hexagonal cobalt using neutron-diffraction techniques. The Heisenberg spin Hamiltonian is introduced and the different types of magnetic interaction are examined. The crystallographic symmetry elements are briefly recalled together with the group concept. An explanation is given of the principles of the matrix method used to analyze magnetic structures. In the case of rare earths, the universal curves for the Néel temperature T_N and the helical angle observed at T_N as a function of the De Gennes parameter $c(g-1)^2J(J+1)$ provide proof of the RKKY coupling between rare earths in high-symmetry sites. The predominant exchange is nevertheless of a pseudo-bipolar nature when the rare earths are found in low-symmetry sites. The correlations between the crystal field, the direction of the moment, and the ground state are illustrated with examples. (FR)

901 METALLOGRAPHY OF PHASE TRANSFORMATIONS. Chadwick, G. A. New York; Crane, Russak and Company, Inc. (1972). 309p. $18.75.

In this book, an atomistic and microstructural approach is taken in the elucidation of the principles of structural metallography. The seven chapters are titled: atomic structure of liquids and solids, binary equilibrium diagrams, solid–liquid interactions, solid–liquid transformations, grain shapes and phase distribution, solid–solid interactions, and solid–state transformations. (DLC)

902 DEFORMATION TWINS IN THE Ni_3Nb PHASE. Grossiord, C.; Turpin, M. (Ecole des Mines, Paris). Met. Trans.; 4: No. 5, 1415-1416(May 1973).

The importance of the {211} twinning mode of the intermetallic phase in the tensile deformation of the Ni–Ni_3Nb eutectic has been reported previously. The samples were tested along their growth direction that is very nearly parallel to the [100] axis of Ni_3Nb. Twinning mode work by Gangloff, Hoover and Hertzberg, Jaswon and Dove, and Grossiord et al. (5th Int. Mater. Symp., Berkeley, Sept. 13–17, 1971) were compared. The author points out that the shear is smaller for type {011} twins than for type {211}. But in the directionally solidified eutectic the shear direction for the former type is nearly parallel to the tensile direction, and the {011} twin is therefore difficult to activate except with large enough triaxial stresses. (JCW)

903 MECHANICAL PROPERTIES OF HAFNIUM SINGLE CRYSTALS. Das, G.; Mitchell, T. E. (Case Western Reserve Univ., Cleveland). Met. Trans.; 4: No. 5, 1405-1413(May 1973).

Deformation of hafnium single crystals (containing ≤2% Zr) was studied in the temperature range from 77 to 473 K. Slip occurred entirely on prismatic planes at all test temperatures. A three-stage hardening behavior was observed at 77 K. The critical resolved shear stress in tension and compression was almost identical for as-grown and ultra-high vacuum (uhv) annealed crystals and was found to increase with decreasing temperature. The yield stress was higher for crystals containing a higher concentration of impurities and was increased by doping crystals with nitrogen. Deformation twins were observed in specimens deformed both in tension and compression. Dislocation configurations were examined by transmission electron microscopy of foils of crystals deformed by various amounts. In stage I the dislocations were found to be predominantly edge in character, with edge dipoles and dislocation loops being present. Stage II was characterized by cell formation and increased dislocation density. The Cottrell–Stokes law for reversible flow stress was not obeyed by hafnium single crystals. The thermal activation analysis suggested that the rate-controlling mechanism during deformation at low strains is associated with the overcoming of strain-fields around impurity atoms. However, contributions from dislocation intersections become increasingly important at higher strains. (37 references) (auth)

904 ISOTOPE EFFECT ON THE SOLVUS OF THE V–H SYSTEM. Westlake, D. G.; Ockers, S. T. (Argonne National Lab., IL). Met. Trans.; 4: No. 5, 1355-1357(May 1973).

The solvus of the V–D system was determined by a resistometric technique. The solubility of deuterium is twice that determined for hydrogen in an earlier study. In the temperature range 210 to 380°K, the solubility limit increases from about 0.6 to 27.4 at. % D. Deuterium causes a smaller increment in the resistivity than hydrogen. (auth)

Radiation Effects

Refer also to abstracts 1095, 1096, 1319, and 1728.

905 (CEA-CONF–2173) CONTRIBUTION OF INTERNAL FRICTION TO THE STUDY OF DEFECTS CREATED BY IRRADIATION. Moser, P.; Pichon, R. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). 1972. 19p. (In French). (CONF-720581–1). Dep. NTIS (U. S. Sales Only).

From Conference on internal friction; Strasbourg, France (5 May 1972).

Internal friction techniques enabled irradiation-induced defects to be studied. The techniques demonstrated how three principal models can be used to interpret defects in metals. The Corbett model explains very well the behavior of the hexagonal metals zirconium and titanium. The Granato model explains the behavior of the body-centered cubic metals iron, molybdenum, niobium, and tungsten. The behavior of the face-centered cubic metals aluminum, nickel, and copper is not well understood, only small-amplitude phenomena appearing. (39 references) (FR)

906 (HEDL-TME-72-21) POST-IRRADIATION RUPTURE LIFE OF ANNEALED TYPE 316 STAINLESS STEEL. Lovell, A. J. (Hanford Engineering Development Lab., Richland, Wash.). Nov 1972. Contract AT(45-1)-2170. 33p. AT $3.75.

Specimens of annealed Type 316 stainless steel were irradiated in EBR-II at temperatures ranging from 900 to 1450°F and to fluences from 0.2 to 7×10^{22} n/cm^2 ($E_n > 0.1$ MeV). Uniaxial and biaxial creep tests were performed at 1000, 1100, 1200, and 1400°F with rupture times from less than 1 to greater than 1000 hours. Data for comparison with HEDL results were obtained from ORNL

tests in EBR-II and UKAEA tests in DFR. The test data clearly show that rupture life changes due to irradiation can be substantial; hence, it is necessary to consider these changes in design. The stress, fluence, and temperature dependence of rupture life was described by a mathematical expression. (12 figures, 10 references) (auth)

907 (IS-M-4) REFRACTORY METALS: PROBLEM AREAS IN RADIATION EFFECTS. Wechsler, M. S. (Ames Lab., Iowa). [nd]. 43p. (CONF-721220-1). Dep. NTIS $4.25.

This review is centered on the bcc metals in groups V–A and VI–A, with some discussion of Re and stainless steel. The role of self-interstitial atoms and interstitial impurity atoms is discussed. The effect of irradiation on the ductile–brittle transition and the temperature dependence of yielding of bcc metals is considered in detail. The radiation-anneal hardening again emphasizes the critical importance of interstitial impurities. Besides the two types of radiation embrittlement discussed (ductile–brittle transition temperature increase and enhanced plastic instability), grain-boundary embrittlement is also considered. Surface effects (radiation blistering and sputtering) are considered briefly. (81 references, 21 figures) (DLC)

908 (JUL-896-FF) INTERACTION OF COPPER INTERSTITIAL ATOMS WITH IMPURITY ATOMS. Kraut, A. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Festkoerperforschung). Nov 1972. 97p. (In German). Dep. NTIS (U. S. Sales Only) $7.00.

The production rate of defects was studied for very dilute alloys of copper containing Au, Be, Co, Mg, Ni, Pd, Sb, or Zn. The defects, interstitial atoms, and lattice holes were produced with a 3-MeV electron beam at 80°K. The defect production rate indicated the interaction of the freely diffusing interstitial copper atoms with lattice holes and foreign atoms. The capture radii of holes and foreign atoms were especially suited for measuring the interaction. These capture radii were tabulated and discussed in detail. To a large extent, experimental values agreed with those calculated according to the elastic continuum theory. Only Be showed a radius about twice as high as the theoretical figure. (HBG)

909 (RT/FI-(72)41) EXAMINATION OF THE DAMAGE TO STAINLESS STEEL BY FAST NEUTRON FLUENCES. Azzoni, P.; Marvasi, R. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 22 Sep 1972. 98p. (In Italian). Dep. NTIS (U.S. Sales Only) $7.00.

Irradiation effects induced in stainless steel by large fast-neutron fluences are examined. Calculations are made to evaluate atom displacements and helium production by (n,α) reactions produced by fast fluences in the PEC reactor and four 1000-MWe fast reactors; different sets of microscopic cross sections are used to obtain an idea of the spread of the theoretical results. Finally, a qualitative evaluation of irradiation effects in the cladding of fuel pins of the PEC reactor loops and of the Na–I Reactor is shown; the axial variation of the temperature and of the fast flux ($E \geq 0.1$ MeV) is taken into account. (18 figures, 20 tables, 44 references) (auth)

910 (WCAP-8022) ANALYSIS AND EXPERIMENTAL VERIFICATION OF THE THERMAL BEHAVIOR OF A FOUR-INCH STEEL SECTION UNDERGOING NUCLEAR HEATING. Heavy Section Steel Technology Program Technical or Programmatic Manuscript No. 22. Legge, S. A. (Westinghouse Electric Corp., Pittsburgh, PA. PWR Systems Div.). Dec 1972. 22p. (HSSTP-22). Dep. NTIS $3.25.

For Oak Ridge National Lab., TN.

An experiment was conducted in the Babcock and Wilcox Test Reactor to demonstrate the capability for predicting temperature distributions in encapsulated heavy steel sections undergoing irradiation. The results proved the validity of calculated temperature distributions in a four-inch thick section subjected to nuclear heating. One dimensional heat flow was assumed in the analysis. The use of auxiliary electrical heat opposite the location of peak temperature helped to flatten the temperature distribution but at the cost of raising the peak temperature. Recommendations are made for the design of future irradiation capsules. (auth)

911 DIRECT MEASUREMENT OF GROSS SELLING IN NICKEL-ION BOMBARDED STAINLESS STEEL. Johnston, W. B. (General Electric Co., Schenectady, NY); Rosolowski, J. H.; Turkalo, A. M.; Lauritzen, T. J. Nucl. Mater.; 46: No. 3, 273-280(Apr 1973).

A technique is described for measuring the total swelling of heavy-ion-bombarded metals. The specimen is partially masked during ion bombardment, and steps are formed at the boundaries of the protected and bombarded regions. The step-height is a measure of the total swelling integrated along the ion path. Experimental step heights on Type 304 steel bombarded with 5-MeV nickel ions are compared with step heights predicted from transmission electron microscopy (TEM) data on void swelling. The agreement between the two provides confirmation of the large swellings (as high as 40 to 50%) measured by TEM. The step-height technique should be particularly useful for measuring large swellings and inhomogeneous swellings, and for rapid screening of alloys and thermomechanical treatments. (auth)

912 RELATION BETWEEN STRESS RELAXATION AND CREEP FOR SOME ZIRCONIUM ALLOYS DURING NEUTRON IRRADIATION. Fraser, D. E.; Ross-Ross, P. A.; Causey, A. R. (Chalk River Nuclear Labs., Ont.). J. Nucl. Mater.; 46: No. 3, 281-292(Apr 1973).

In-reactor stress-relaxation tests on beam specimens of several zirconium alloys were performed at 566°K in a fast-neutron flux ($E > 1$ MeV) of 2×10^{17} n/m^2·s. The stress-relaxation behavior is characterized by an initial rapid decrease in the unrelaxed stress ratio followed by a slower steady-state decrease which can be expressed by the relation $\ln(\sigma/\sigma_0) = -(AE)t + \ln D$, where σ/σ_0 is the unrelaxed stress at a given time t as a fraction of the initial stress σ_0, A is a flux-, material-, temperature-dependent constant, E is Young's modulus, and D is given by σ_p/σ_0 where σ_p approximates the initial stress decrease. The linear dependence of $\ln(\sigma/\sigma_0)$ on time and the independence of the stress-relaxation behavior on the initial stress implies that the creep rate in the steady-state period can be given by the expression, $\dot{\epsilon} = A\sigma$. Good agreement was obtained between creep rates derived from stress-relaxation tests on experimental pressure tube materials and creep rates derived from diameter measurements of pressure tubes for identical temperature, flux and stress conditions. (auth)

913 IRRADIATION CREEP DURING VOID PRODUCTION. Lewthwaite, G. W. (Dounreay Experimental Research Establishment, Caithness, Scotland). J. Nucl. Mater.; 46: No. 3, 324-328 (Apr 1973).

It is desirable for technological reasons to develop theories that can relate irradiation creep with swelling. Such a correlation is attempted here by developing an idea due to Hesketh and applying it to the formation of Frank loops containing interstitial atoms produced during void production. Observation suggests that the number of interstitials in loops is equal to the number of vacancies in voids and it is this equality which allows the creep strain to be linked to the swelling. The calculated ratio of creep and swelling is compared with values recently deduced from experiments with pressurized tubes and it is found that the calculated creep strain is an order of magnitude less than the deduced value. Agreement between theory and experiment can be achieved only by either abandoning the equality of the numbers of interstitials in loops and vacancies in voids or by assuming that an interstitial loop nucleus contains about 30 atoms. (auth)

914 EFFECT OF COLD-WORK AND STRESS-RELIEVING ON THE IRRADIATION-GROWTH BEHAVIOR OF ZIRCONIUM ALLOYS. Fidleris, V. (Chalk River Nuclear Labs., Ont.). J. Nucl. Mater.; 46: No. 3, 356-360(Apr 1973).

Experimental results are reported for Zircaloy-2 and Zr–2.5 wt.% Nb irradiated by fast neutrons at 120 to 360°C. Some specimens were irradiated in the as-cold worked (40%) condition, while others were first stress-relieved for various times at 400°C or annealed 1 h at 800°C. Results indicate that there are at least three components of dimensional change–texture, stress relief, and cold work. The changes due to texture and stress relief can be of either sign and saturate at fluences of $\leq 1 \times 10^{24}$ n/m^2. Cold work adds a component of positive length change in the working direction whose rate does not diminish even after 2.7×10^{25} n/m^2. (DLC)

915 INFLUENCE OF COLD DEFORMATION ON VOID FORMATION IN ALUMINUM ON IRRADIATION. Risbet, A.; Levy, V. (CEN, Saclay, France). J. Nucl. Mater.; 46: No. 3, 341-352(Apr 1973). (In French).

Aluminum samples, either annealed or in the as-deformed condition, were subjected to irradiation doses ranging from 8×10^{19} to 3.1×10^{21} n/cm^2. Initial deformation raises the degree of swelling associated with voids in aluminum irradiated at 55°C, but reduces it at 220°C. In annealed aluminum the loops are sometimes interstitial-type, sometimes vacancy-type; the appearance of void is linked to an increase in the density of dislocations. Examination of samples stretched by different amounts shows that, at a fixed temperature, swelling is a function of the dislocation density introduced initially. (auth)

916 TRAPS CREATED IN THE SINGLE CRYSTAL OF CdSe BY IRRADIATION OF Mo Kα X-RAY QUANTUM. Joshi, N. V.; Ballestero, R. (Univ. of Los Andes, Merida, Venezuela). Phys. Lett.; 43A: No. 3, 307-308(12 Mar 1973).

Traps were created in the single crystal of CdSe by bombardment with Mo Kα x-ray radiation. These traps were studied by

the relaxation curves of photoconductivity, obtained at 6000 Å and after two dosages of radiation. It has been found out that the traps created were β-type. (auth)

917 DEFECT PRODUCTION RATE AT TEMPERATURES ABOVE STAGE I. Schroeder, K.; Heidrich, W. (Kerforschungsanlage, Juelich, Ger.). Phys. Lett.; 43A: No. 3, 315-316 (12 Mar 1973).

An analytical expression is derived for the damage production rate by electron irradiation, considering the screening of the correlated vacancy by large concentrations of vacancies and impurity atoms. (auth)

918 EFFECTS OF ION BOMBARDMENT ON THE SURFACE OF METAL CRYSTALS. Hermanne, N. (Univ. Libre, Brussels). Rev. Roum. Phys.; 17: No. 6, 747-749(1972).

A short review and a restatement are given of the question of surface roughness on bombarded crystals. Radial bombardment of single-crystal spheres and examination of irradiated thin foils were used to study the effects of 5- and 60-keV Ar^+ ions on Cu. A regular structure of facets develops which is not caused by thermal etching. (DLC)

919 ULTRASOUND AND RADIATION DAMAGE. Pollard, H. F. (Univ. of New South Wales, Kensington, Australia). At. Energy Aust.; 16: No. 1, 27-34(Jan 1973).

By measuring the changes in velocity and damping of a high-frequency wave, detailed information may be obtained on the internal structure of a solid, especially in relation to the distribution of dislocations and their interaction with point defects and impurities. A beam of radiation has been found to be a flexible means for altering the point-defect population in a crystal. Some results for Cu and NaCl monocrystals are discussed. In alkali halides the dislocations become almost fully pinned before any measurable concentration of F centers is built up in the bulk of the crystal. Transient effects (interrupted radiation) and high-amplitude effects are discussed. (AT)

920 GAMMA-RAY EFFECTS ON THIN METAL FILMS. Korshunov, V. D.; Tarakanov, V. I. (Taganrog Radiotechnical Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 11, 143-145 (1972). (In Russian).

Thin films of Sn, Ni, Ag, Cu, Au, V, Pd, and Ta were prepared by thermally vaporizing the metals in a vacuum and films of Ti by cathode sputtering. The films were subjected to ^{60}Co gamma radiation, and the changes in electrical resistance were noted. Films of Au, Ti, and Ta were considered stable toward radiation. Irradiation in air of Ni, Cu, Ag, V, Sn, and Pd caused intense oxidation of the surfaces; protection from the air increased the stability of the electrical resistance by factors of 10 and 100. (KSW)

921 INFLUENCE OF QUENCHING CONDITIONS ON SWELLING DURING NEUTRON IRRADIATION OF A NIOBIUM AUSTENITIC STEEL. *Silvent, A.; Sainfort, G. (CEN, Grenoble, France).* J. Nucl. Mater.; 46: No. 3, 259-267(Apr 1973). (In French).

Steels of type AISI 316 and 318 which had been subjected to different heat treatments were neutron-irradiated at 450°C to a fluence of 5×10^{21} n/cm^2. Density measurements after irradiation reveal a swelling of 0.15% for AISI 316 and 318 steels quenched from 1050°C and tempered at 700°C. A homogeneous dispersion of niobium carbide does not appear to influence the amount of swelling. On the other hand, the AISI 318 steel hyperquenched from 1270°C and tempered at 700°C swells to an extent of only 0.025%. Examination by electron microscopy showed that this reduction in swelling is associated with the dispersion of the fine niobium carbide precipitates on extrinsic stacking faults, as a consequence of the heat treatment. It was noted that voids were absent in the neighborhood of these stacking faults with their associated precipitates. (auth)

922 CHANNELING OF LIGHT IONS (0.5 TO 2 MeV) THROUGH GOLD CRYSTALS OF A FEW HUNDRED ANGSTROMS THICKNESS. Poizat, J. C.; Remillieux, J. (Lyon Univ., Villeurbanne, France). J. Phys. (Paris); 33: No. 11, 1013-1025(Nov 1972). (In French).

A technique was developed for obtaining self-supporting Au crystal targets having thicknesses of a few hundred angstroms. Three different series of light ion channeling experiments (0.5 to 2 MeV) carried out with these crystals are presented: study of the variation in probability of large-angle scattering for a particle beam injected parallel to the crystal planes or in the direction of the crystal axes, with the depth of penetration; study of directional effects in the quantity of light emitted by an atomic beam excited during its passage through a thin crystal; establishment of the existence of a strong channeling effect on the transmission probability of a H_2^+ molecular ion beam through a thin crystal. (France)

923 Er–Y, Tb–Ho, Tb–Er, Dy–Ho, Dy–Er, AND Ho–Er PHASE SYSTEMS. Spedding, F. H.; Sanden, B.; Beaudry, B. J. (Ames Lab., Iowa). J. Less-Common Metals; 31: No. 1, 1-13 (Apr 1973).

These systems were studied by thermal, x-ray, and metallographic measurements made on very pure metals. These systems are characterized by complete mutual solubility and within experimental errors, no enrichment of one rare earth over the other was observed during solidification or transformation. The solidus and liquidus lines, therefore, fell on top of one another over the entire composition range. The addition of Er to Y or Y to Er lowers the melting point which reaches a minimum at 53 at.% Er. Alloys containing less than 53 at.% Er solidify to a bcc lattice which transforms at lower temperatures to a hcp lattice. Alloys with greater than 53 at.% Er crystallize directly to the hcp solid solution. For the Tb–Ho, Tb–Er, Dy–Ho, and Dy–Er systems, the melting point appears to decrease linearly with increasing at.% of the lower atomic numbered rare earth. However, when the atomic number of the components are two or more apart, there may be a very slight negative deviation from linearity which reaches a maximum at the composition where the bcc first starts to form from the melt. This is especially evident in the Dy–Er system in which the negative deviation could be interpreted as a slight change in slope occurring at the composition where the bcc first starts to form from the melt. The bcc starts to form at 10 and 34 at.% Tb in the Tb–Ho and Tb–Er systems and at 25 and 50 at.% Dy in the Dy–Ho and Dy–Er systems, respectively. The transformation temperature is lowered linearly from these points with increasing composition of the lighter rare earth to the transition temperature of the pure solute. The Ho–Er system has a linear variation of melting points with composition. The a and c lattice parameters vary linearly with composition within experimental errors for the binary systems of adjacent elements. By the time the elements are four apart in the series, Tb–Er, a distinct deviation from linearity occurs in the plot of lattice constant versus composition which is positive for the a axis and negative for the c axis. (auth)

Other Materials

Refer also to abstracts 566, 594, 777, 919, 1096, 1572, and 1582.

924 (AERE-R-6660) PROJECTED ION RANGE DATA FOR SILICON PLANAR TECHNOLOGY. Smith, B. J. (Atomic Energy Research Establishment, Harwell (England)). Feb 1971. 246p. Dep. NTIS (U. S. Sales Only) $14.50.

This report presents in graphical form the theoretical distribution of ion-implanted impurities in a number of targets. Ion species (groups IIIA and VA, H, Ar, Ne, Si) and target materials (Al, Au, Cu, Mo, SiN, SiO_2, Al_2O_3, photoresist) are those encountered in silicon planar technology. The distributions are calculated from the equations of Lindhard, Scharff and Schiott. (auth)

925 (COO-3245-2) OPTICAL SPECTROSCOPY OF ^{237}Np IN CaF_2. Progress Report, May 1, 1972–April 30, 1973. Artman, J. O. (Carnegie-Mellon Univ., Pittsburgh, PA). [nd]. Contract AT(11-1)-3245. 6p. Dep. NTIS. $3.00.

Green-colored ^{237}Np-doped CaF_2 monocrystal specimens were grown on a reasonably reproducible basis. The optical adsorption spectra of these samples were particularly simple ("A" spectrum) when Li^+ was added to the mix for charge-compensation purposes. The lowest absorption noted was at 2.2 μm which is attributed to the $^3H_4$ (ground state) $\rightarrow$ $^3F_2$ transition of Np^{5+} ($5f^2$). Samples prepared without Li^+ compensation displayed "AB" spectra which were composites of the "A" spectrum and a new "B" spectrum. The observed B spectrum crystal-field splittings were much greater than those of the A spectrum, and the lines were also more numerous. The B spectrum is also assigned to Np^{5+}. To date, crystals possessing just B-type spectra could not be grown. Tentatively, the A spectrum is associated with a nominal 3-fold symmetry axis and the B spectrum with a nominal 4-fold axis. Parametric analyses of the splittings of the levels are in progress. (auth)

926 (COO-3418-9) NONLINEAR ELASTIC AND THERMOELASTIC PROPERTIES OF HIGH-TEMPERATURE MATERIALS. Final Report. Barsch, G. R. (Pennsylvania State Univ., University Park. Materials Research Lab). Apr 1973. Contract AT(11-1)-3418. 25p. Dep. NTIS $3.25.

The pressure dependence of the single-crystal elastic constants was measured at 300°K for RbCl, RbBr, RbI, NaI, KI, wurtzite, and UO_2 between 300 and 500°K for CsI, between 37 and 300°K for V_3Si, and between 13 and 300°K for V_3Ge. Except for UO_2 and for the longitudinal moduli in wurtzite, the pressure dependence was found to be nonlinear in the pressure range up to about 4 kbar for

the rubidium halides, or 10 kbar for the other materials. The complete set of third-order elastic constants was measured at 300°K for UO_2 single crystals, Al_2O_3 single crystals, and Al_2O_3 polycrystals. For vitreous silica, the complete sets of third- and fourth-order elastic constants were measured at room temperature. The results for most of the nonmetallic materials could be satisfactorily explained on the basis of the rigid ion model (alkali halides) and the shell model (UO_2). The data were used for the calculation of first and second Grueneisen parameters, both in the anisotropic continuum approximation and (for alkali halides) on the basis of the shell model, for the isothermal equation of state at high pressure, to the discussion of crystal stability in relation to high-pressure phase transformations, and for the calculation of the pressure coefficients of the superconducting transition temperatures in V_3Si and V_3Ge. In general, good to fair agreement between calculated and measured qualities was obtained.

927 *ION IMPLANTATION. Conference Held at Thousand* Oaks, California, May 4–7, 1970. Eisen, F. H.; Chadderton, L. T. (eds.). New York; Gordon and Breach, Science Publishers, Inc. (1971). 474p. (CONF-700544–(Pt.2)). $22.50.

From international conference on ion implantation in semiconductors; Thousand Oaks, California, USA (4 May 1970).

The fifty-eight papers of this collection were published in Radiation Effects, Vol. 6, Nos. 1 and 2 (Nov. 1970) and Vol. 7, Nos. 1 and 2 (Jan. 1971). They were abstracted previously in NSA Vol. 25: abstract Nos. 6534, 19760, 19810 through 19848, 27854 through 27864, and 37675 through 37680. (LMT)

928 RECOMBINATION LUMINESCENCE LIFETIMES AND *THE SELF-TRAPPED EXCITON IN ALKALI HALIDES.* Fischbach, J. U. (Univ., Frankfurt am Main); Froehlich, D.; Kabler, M. N. J. Lumin.; 6: No. 1, 29-43(Jan 1973).

The decay of recombination luminescence in undoped KI and RbI at low temperatures was measured following pulsed excitation by two-photon absorption and other methods. Several distinct exponential components are observed whose decay times vary with temperature. The most notable case is the principal component of the intrinsic luminescence in KI, whose decay time increases exponentially from 2 μsec at 12°K to 280 μsec at 1.38°K. The data are accounted for in terms of changing populations within a zero-field-split triplet state of the self-trapped exciton. Evidence concerning the origin of a second luminescent triplet state in KI, RbI, and CsI is discussed; this state is similar to those of the self-trapped exciton, but may involve an extrinsic perturbation. 23 references. (auth)

929 *EFFECT OF PRE-STRESSING AND ANNEALING ON* YOUNG'S MODULUS OF SOME NUCLEAR GRAPHITES. Eto, M.; Uko, T. (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Mater.; 46: No. 3, 315-323(Apr 1973).

Studies were made on the decrease in the dynamic Young's modulus of some nuclear graphites caused by pre-stressing or cyclic loading in compressive mode and its recovery due to annealing up to 2000°C. It is found that the decrease in the modulus is well represented by the formulae, $E/E_0 = -A\sigma^2 + B$ for extruded graphites and $(E - E_c)/(E_0 - E_c) = B \exp(-A\sigma^2)$ for molded ones, where E, E_c and E_0 are the modulus at a pre-stress σ, that at pre-stress equal to fracture stress and that with no pre-stressing, respectively. A and B are constants. Annealing experiments show that the moduli of extruded graphites recover almost completely below 1000°C, while in the case of molded graphites complete recovery is not attained even at 2000°C. The activation energy obtained for the recovery of an extruded graphite below 1000°C is about 0.6 eV. (auth)

930 COUNTER-DIFFRACTOMETER PARAMETER DETERMINATION OF POLYCRYSTALLINE U_3Si. De Vooght, D.; Verniers, G.; De Meester P. (Katolieke Univ., Leuven, Belgium). J. Nucl. Mater.; 46: No. 3, 303-308(Apr 1973).

The present study deals with an x-ray diffraction analysis of U_3Si. The U_3Si lattice parameters were determined to a more accurate degree by means of a counter diffractometer step-scan apparatus. The intensities of the reflections were also recorded and compared with the calculated values. The discrepancies between calculated and observed intensities are discussed; they are probably caused by periodic faulting. Results are: $a = 6.0323 \pm 0.0004$ Å, $c = 8.6907 \pm 0.0006$ Å, $c/a = 1.4406 \pm 0.0002$. (auth)

931 *INFLUENCE OF TEMPERATURE ON ANODIC OXIDA*TION OF NIOBIUM IN PHOSPHATE SOLUTIONS. Ammar, I. A.; Ismail, I. K. Metalloberflaeche; 26: No. 10, 378-381(Oct 1972). (In German).

Anodic oxidation of Nb was studied in 0.1 M $NH_4 \cdot H_2PO_4$ at 20 to 70°C. The oxide formation rate is related to the ionic c.d., i, by a log/log relation at all temperatures. The slope of the relation between unitary formation rate R_i (or field) and log i is independent of temperature. The results are interpreted in terms of the simple kinetics of galvanostatic anodization based on the exponential law of Guntherschulze–Betz, which is satisfactory for a limited range of c.d. or field. (Metals Abstr.)

932 EFFECT OF INTERPORE REACTION ON THE INTERACTION OF CARBON DIOXIDE WITH GRAPHITE. Nechaev, V. N.; Kantorovich, B. V. pp 78-83 of Novyye Metody Szhiganiya Topliva i Vopr. Teorii Goreniya. Moscow; Izdatel'stvo Nauka (1972). (In Russian).

Experiments were conducted to show the depth of penetration of the reaction of CO_2 with graphite. The studies were conducted on graphite channels of different thickness: 4.0, 2.0, and 0.7 mm at T = 1400 to 2400°K. It was established that in a channel with wall thickness δ equal to 0.7 mm the reaction occurs in the temperature interval 1400 to 1500° in order of magnitude close to zero with activation energy E = 80 ± 5 kcal/mole. (JPRS)

933 SYNTHESIS OF ZIRCONIUM CARBIDES IN A NaCl MELT. Zainulin, Yu. G.; Alyamovskii, S. I.; Shveikin, G. P.; Gel'd, P. V. (Inst. of Chemistry, Sverdlovsk, USSR). Dokl. Akad. Nauk SSSR; 207: No. 1, 105-106(1 Nov 1972). (In Russian).

Briquettes of ground and mixed iodide zirconium or zirconium hydride and lampblack were introduced into liquid NaCl at 850°C. After a few minutes, the mixture was cooled and leached with water to dissolve out the NaCl. No reaction occurred in the case of Zr metal; in experiments where $ZrH_{1.4}$ was used, evolution of H_2 and the formation of ZrC_x were observed. The lattice constants of the ZrC_x agreed satisfactorily with the literature data. (KSW)

934 PLANAR SILICON DIODES PRODUCED BY ION IMPLANTATION. Sachuk, K.; Kunicki, J.; Krylow, J. (Inst. of Electronic Engineering, Warsaw). Elektronika; 13: No. 12, 494-497(Dec 1972). (In Polish).

Ion implantation was used on a laboratory scale to produce n-type planar silicon diodes similar to the BA-508 varicap. A DANFYSIK implantor and an isotope separator from the Institute of Nuclear Physics (Instytut Fizyki Jadrowej) in Krakow were used for this purpose, to dope the specimens with 100- or 40-keV boron ions at a rate of 10^{15} cm^{-2} at room temperature through a 6000-Å-thick SiO_2 mask. The success of this technique was evaluated on the basis of certain critical electrical measurements: resistivity, capacitance–voltage, current–voltage characteristics, and breakdown voltage. The constant slope of the volt–ampere curves (log I): V = 1.5 indicates the presence of generation and recombination centers in the p–n junction region, but some shifting of the characteristic is due to differences in the concentration of majority carriers within the doped regions. Two series of such diodes were thus produced and tested: 24/20 with and 16/B without an ion beam deflection system in the separator. (JPRS)

935 THRESHOLD CURVE FOR THE DISPLACEMENT OF ATOMS IN GRAPHITE. Montet, G. L. (Argonne National Lab., IL). Carbon; 11: No. 2, 89-92(Apr 1973).

Previous work utilizing the etch-decoration technique to determine the threshold energy for the displacement of atoms in graphite has been extended to the elucidation of the initial portion of the displacement curve. The availability of an electron beam of precisely defined energy of up to 500 eV has made possible the mapping out of the curve up to 135 eV. The shape of the displacement curve differs somewhat from the cross-section curve obtained from measurements of the change in electrical resistivity of electron-irradiated graphite but is very similar to that obtained by in situ electron-microscopic studies. A linear extrapolation of the initial portion of the displacement curve yields a value of 29.7 eV for the threshold energy in good agreement with that determined directly. (auth)

936 THERMAL DIFFUSIVITY AND THERMAL CONDUCTIVITY OF PYROLYTIC GRAPHITE FROM 300 TO 2700°K. Null, M. R.; Lozier, W. W.; Moore, A. W. (Union Carbide Corp., Parma, OH). Carbon; 11: No. 2, 81-87(Apr 1973).

The thermal diffusivity and thermal conductivity of as-deposited, annealed, and stress-annealed pyrolytic graphite were measured at room temperature and over the range 1500 to 2700°K. Values of the thermal conductivity parallel to the plane of deposition compare reasonably well with published results on similar materials, as do the values in the perpendicular direction at room temperature. The conductivity values in the perpendicular direction for the annealed and stress-annealed materials are the first reported for such highly oriented materials at temperatures above 900°K, and they follow approximately a T^{-n} dependence with $n \leq \frac{1}{2}$ over the temperature range 1500 to 2700°K, where the conductivity is two-to-three times larger than expected from a T^{-1} extrapolation from room temperature. (auth)

937 STUDY OF INTERSTITIAL CLUSTERS IN IRRADIATED ALKALI HALIDES USING DIRECT ELECTRON MICROSCOPY.

Hobbs, L. W. (Oxford Univ.); Hughes, A. E.; Pooley, D. Proc. Roy. Soc. (London), Ser. A; 332: No. 1589, 167-185(6 Mar 1973).

A technique was developed for preparing foils of alkali halide crystals less than a few hundred nanometers thick for observation in the microscope, and a liquid-helium-cooled stage allows the study of irradiated crystals down to 5°K, where it is possible to analyze clusters produced at other temperatures, without confusion from observable electron-beam damage. Irradiations were performed both in the 100-keV microscope beam and externally using γ rays or 400-keV electrons. In this way irradiation products in KI were extensively studied. The predominant type of defect cluster produced in several alkali metal halides by room temperature irradiation has contrast typical of planar dislocation loops. Tilt/contrast experiments performed in KI show conclusively that the loops are interstitial in character, and the numbers of point defects involved and the temperature dependence of their growth indicate that mobile interstitial halogen atoms are required for their formation. The loops have Burgers vectors $b = \frac{1}{2}\alpha\langle 110\rangle$ where α is the lattice parameter. The habit plane of a loop with $b = \frac{1}{2}\alpha[101]$ lies between (001) and (101). An unfaulted interstitial dislocation loop with Burgers vector $\frac{1}{2}\alpha\langle 110\rangle$ formed by condensation of equal numbers of anion and cation interstitials can account for the observed features of the clusters. However, since there is little evidence for the direct production of cation Frenkel pairs by ionizing radiation in alkali metal halides, alternative models are presented in which the cluster forms primarily as a result of the initial aggregation of halogen interstitials alone. These models are shown to be consistent with specific features of the radiation damage behavior of alkali metal halides. (auth)

938 EFFECT OF IMPURITIES AND X-RAY IRRADIATION ON BUBBLE MOTION IN CRYSTALS INDUCED BY APPLICATION OF EXTERNAL ELECTRIC FIELD. Geguzin, Ya. E.; Kruzhanov, V. S.; Konstantinov, V. A.; Simeonov, S. S. (Kharkov State Univ.). Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 1, 62-65(Jan 1973). (In Russian).

The electric field-induced motion of bubbles in NaCl and KCl single crystals was studied. The observed dependence of velocity of the bubbles v vs R (bubble radii) consists of two distinct parts. For bubbles with $R < R^*$, v is independent of R and for bubbles with $R > R^*$ $v \sim 1/R$. R^* is about 10 μm. It is shown that small concentrations of impurities may both increase and decrease the bubble velocity. X-ray irradiation decreases velocity of the bubbles. (auth)

939 THERMOLUMINESCENCE OF MgF_2 CRYSTALS IRRADIATED BY ELECTRONS AND PROTONS. Zavadovskaya, E. K.; Lisitsyn, V. M.; Rylkin, Yu. A.; Shishkin, I. S. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 11, 124-126(1972). (In Russian).

Crystals of MgF_2 were grown in a F_2 atmosphere, mechanically polished, and annealed at 450°C for 2 hours. Specimens were exposed to a flux of either 1.2-MeV electrons or 4.5-MeV protons. Thermoluminescence was studied over the temperature interval 20 to 450°C at a heating rate of 6°/min. The proton-irradiated MgF_2 exhibited light peaks at 100, 120, 320, and 360°C, the relative intensities of the peaks depending on the radiation dose. Analogous results were obtained with the electron-irradiated MgF_2. (KSW)

940 OPTICAL ABSORPTION SPECTRA OF SODIUM BORATE GLASSES IRRADIATED BY ELECTRONS. Vakhromeev, V. G.; Zinov'eva, S. P. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz., No. 11, 154-155(1972). (In Russian).

Resolution of discrete bands in the optical absorption spectra (1 to 6 eV) of borate glass of the composition $4.5\ B_2O_3 \cdot 1\ Na_2O$ was sought following exposure to 1.2-MeV electrons in air near room temperature. The bands observed in irradiated glass were poorly defined with poor resolution of the spectra. (KSW)

941 RADIATION-INDUCED CHANGES IN THE ORIENTATION ANISOTROPY OF PYROCARBON COATINGS ON FUEL OXIDE PARTICLES. Koizlik, K. (Kernforschungsanlage, Juelich, Ger.); Koss, P. Atomwirt., Atomtech.; 18: No. 1, 29-31(Jan 1973). (In German).

The reported experimental results indicate two premises for increased orientation anisotropy of pyrocarbon coatings on fuel oxide particles. For structural changes in the pyrocarbon coating to occur, the coating must contain a high enough number of defects that creeping processes can proceed. The defects are produced either thermally or through fast neutrons at the relatively low radiation temperature around 1000°C. For structural changes to cause an increased orientation anisotropy, the coating must contain strong macroscopic tensions that lead to directed creeping processes. The tensions are produced either through gas pressure in the interior of the particles or through swelling and shrinking of the coating under the influence of fast neutrons. (tr-auth)

942 MAGNETIC ANISOTROPY OF THE URANIUM COMPOUNDS UAsS AND UAsSe. Belov, K. P.; Dmitrievskii, A. S.; Zygmunt, A.; Levitin, R. Z.; Trzebiatowski, V. (Moscow State Univ.). Zh. Eksp. Teor. Fiz.; 64: No. 2, 582-586(Feb 1973). (In Russian).

The magnetization of UAsS and UAsSe compounds along various crystallographic directions is measured in stationary magnetic fields up to 12 kOe and in pulsed magnetic fields up to 200 kOe. The compounds are ferromagnetic at low temperatures and possess very high magnetic anisotropy. In the ferromagnetic region, the magnetization in the difficult magnetization direction (basal plane of the crystal) is not saturated even in fields up to 200 kOe. The saturation is estimated to be of the order of 1000 kOe. In the paramagnetic region, the susceptibility in the basal plane is smaller than that along the tetragonal crystal axis by an order of magnitude. The enormous magnetic anisotropy of UAsS and UAsSe is qualitatively explained within the framework of the crystal-field theory. (auth)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

Accountability and Safeguards

943 (LA-UR-73-185) EXPANDING ROLE OF THE SMALL VAN DE GRAAFF IN NUCLEAR NONDESTRUCTIVE ANALYSIS. Evans, A. E. (Los Alamos Scientific Lab., N. Mex.). 1972. Contract W-7405-eng-36. 4p. (CONF-730310-7). Dep. NTIS.

From fifth particle accelerator conference; San Francisco, California, USA (5 Mar 1973).

In support of nuclear safeguards, a 3-MeV Van de Graaff accelerator was installed at LASL to aid research in techniques for nondestructive assay of fissionable materials. Monoenergetic neutrons make possible fissile assay techniques less influenced by self-absorption than thermal interrogation and more discriminating of fissile over fertile material than use of partially moderated high-energy neutrons. Delayed fission-neutron counting, a valuable assay technique, is facilitated by pulsed neutron on-to-off ratios in excess of 10^9, achieved with special beam-handling techniques. Where high neutron backgrounds, e.g., from samples containing ^{240}Pu, preclude delayed-neutron counting, fission prompt-neutron counting with an energy-biasable detector is applied. The increasing facility workload which includes detector development and calibration, research in trace analysis by proton-induced x-ray fluorescence and research in light-element isotopic assay by means of charged-particle induced reactions indicates that technological application may more than supplant dwindling nuclear research as a market for accelerators of this class. (auth)

Disposal and Storage

Refer also to abstracts 360, 362, and 1563.

944 (ORNL-TM-4024) PRELIMINARY EVALUATION OF METHODS FOR THE DISPOSAL OF TRITIATED WATER FROM NUCLEARLY STIMULATED NATURAL GAS WELLS. Arnold, W. D.; Salmon, R.; Lin, K. H.; de Laguna, W. (Oak Ridge National Lab., Tenn.). Apr 1973. Contract W-7405-eng-26. 52p. Dep. NTIS $3.00.

Proper disposal of tritiated water produced from nuclearly stimulated natural gas fields is essential to the success of nuclear stimulation in natural gas recovery. The feasibility, safety, and cost of the following methods for tritiated water disposal were compared: deep-well disposal; evaporation into stacks; evaporation into ponds, long-term tank storage; shipment off-site; discharge into streams; discharge into atmosphere as tritium gas; and isotopic separation. It was concluded that deep-well injection, evaporation into stacks, and evaporation from ponds are the most favorable methods and that each of these methods has potential advantages and disadvantages which must be evaluated during production testing of the first Rio Blanco well. (LCL)

945 (SCPRI-A-142) PRINCIPLES GOVERNING THE LICENSING OF WASTE DISPOSAL. Chanteur, J. (Service Central de Protection Contre les Rayonnements Ionisants, le Vesinet (France)). 1972. 7p. (In French). (CONF-720453-3). Dep. NTIS (U. S. Sales Only) $3.00.

From meeting on disposal of radioactive waste; Paris, France (12 Apr 1972).

An experimental period has elapsed during which the regulations concerning the disposal of radioactive wastes (especially liquid wastes) were established from agreements between the appropriate concerns and the public health authorities. A phase in the industrial production of nuclear energy is now being reached in which it is absolutely necessary that liquid and gaseous waste disposal is subjected to statutory regulations. Principles concerning the obligations of exploiting concerns are enumerated, i.e., explicit prior authorization; the responsibility of the concern to provide proof that it is operating within the framework of the regulations; the possession of the appropriate means to respect the fixed limits and to carry out effective controls; the assurance of the exploiting concern that the activity that it will be disposing conforms to the established regulations; and the recording of information and the effecting of intercomparisons. (FR)

946 METHOD OF BITUMINIZING RADIOACTIVE WASTES RETAINED IN NATURAL SORBENTS. II. Radioisotope Investigation with the Alkaline Earth Metals ^{90}Sr AND ^{45}Ca. Daiev, Kh.; Delchev, G.; Gradev, G.; Simov, S.; Zelyazkov, V. Izv. Fiz. Inst. Aneb, Bulg. Akad. Nauk.; 22: 187-193(1972). (In Russian).

Experiments showed that a preliminary heating of vermiculite to 500°C increased its capacity as a sorbent for radioactive materials such as ^{90}Sr and ^{45}Ca. The sorbent containing the alkaline earth metals was sealed in a cast bituminous mold for preservation. Various kinds of bitumen were tested for their behavior in the application of this bituminizing method; a petroleum-derived asphalt Rubrax was superior to a "hydroisolant" bitumen. (KSW)

947 METHOD OF BITUMINIZING RADIOACTIVE WASTES RETAINED IN NATURAL SORBENTS. I. Radioisotope Investigation with Monovalent Cations ^{137}Cs, ^{204}Tl, and ^{110m}Ag. Daiev, Kh.; Delchev, G.; Zhelyazkov, V.; Gradev, G.; Simov, S. Izv. Fiz. Inst. Aneb, Bulg. Akad. Nauk.; 22: 179-186(1972). (In Russian).

In this method of treating radioactive wastes, the radioactive solutions are filtered through a vermiculite-zeolite mixture to the point of "saturation" of the sorbent. The solid materials are sealed in a bituminous mold which is then ready for open-air storage. The method described has been applied to decontaminating radioactive solutions containing ^{137}Cs, ^{204}Tl, and ^{110m}Ag at a level corresponding to category No. 3 of the I.A.E.A. (10^{-3} to 10^{-1} mCi/l). (tr-auth)

948 DISCHARGE OF RADIOACTIVE WASTE WATERS FROM INSTALLATIONS USING ISOTOPES. Gemeinsames Amtsbl., A; 20: No. 24, 758-760(1972). (In German).

According to the First Radiation Protection Ordinance, waste waters from controlled areas may not be released into sewers or surface waters unless their concentration of radioactive materials does not exceed the average daily permissible limit. As an exception to this rule, the appropriate authorities may allow the discharge of waste waters of a higher concentration if this does not imply a danger to individuals or to the general public, and if there are no objections to be raised with a view to the conservation of surface waters. The principles and stipulations to be observed in the granting of such a permission according to the First Radiation Protection Ordinance are set forth. (GF)

Handling Equipment and Procedures

Refer also to abstracts 352 and 1563.

949 (ANL/HFEF-5) STUDY FOR HFEF DATA-ACQUISITION AND PROCESS-CONTROL SYSTEM. Rizzie, J. W.; Just, F. H.; Bono, R. W. (Argonne National Lab., Idaho Falls, Idaho). Nov 1972. Contract W-31-109-eng-38. 43p. Dep. NTIS $4.25.

The Hot Fuel Examination Facility (HFEF) data-acquisition and process-control system described will use a programmed digital controller (PDC) and a standardized modular dataway to control remote-examination processes and data-gathering functions in the two HFEF hot-cell facilities. The digital data highways will employ the CAMAC modular instrumentation system for data handling and control. The process-control system will be based on a preplanned control strategy that will be valid over the approved range of conditions. The objectives of the system will be to establish a control room where the PDC, with the help of its peripherals, can command and service the data highways that extend to the hot-cell processes. The system will also be used as a proving ground for the development and standardization of modular systems for the control of remote hot-cell processes. (auth)

950 (WCAP-7055) CRITICALITY CONTROL PARAMETERS AND SUPPORTING CALCULATIONS FOR PLUTONIUM AND/OR URANIUM BEARING NUCLEAR FUEL. Lacey, P. G. (Westinghouse Electric Corp., Pittsburgh, PA). May 1967. 72p.

Criticality control parameters for plutonium and/or uranium bearing fuels in the form of powders, pellets, and rods for Pu compositions up to and including 100% ^{239}Pu in the Pu, are given. Major emphasis is given to the mixed oxide form PuO_2-UO_2 where the U is natural enrichment uranium. Limits are given for four typical mixture ratios, namely 2.0, 6.6, 15.0, 20.0, in addition to 100.0 wt.% of PuO_2. For enrichments above 20 wt.% safe values given for PuO_2 may be conservatively used. Since laboratory operations are also covered, it was necessary to include safe handling limits for both ^{233}U and ^{235}U enriched uranium as well as for plutonium. Limits are given for homogeneous mixtures of fuel and H_2O moderator as well as for heterogeneous mixtures of fuel pellets and H_2O moderator. The data given for individual isolated units are: safe mass for any size container, safe diameter of an infinite cylinder, safe thickness of an infinite slab, and safe volume of a sphere. Criticality safety evaluation of arrays of fissile units is not covered, but brief mention of criticality control methods is made. (auth)

951 (Y-DR-12) CRITICALITY CALCULATIONS FOR THE DESIGN OF LARGE PULSED EXTRACTION COLUMNS. Magnuson, D. W. (Oak Ridge Y-12 Plant, Tenn. (USA)). 28 Mar 1969. Contract W-7405-eng-26. 8p. Dep. NTIS $3.00.

Criticality calculations have been performed to show the increases in critical radii for infinite cylinders of $^{239}PuO_2-H_2O$ *mixtures due to stainless steel plates having various amounts of gadolinium for neutron absorption. The calculated column diameter is approximately 10 in. for a solution concentration of 150 g of* ^{239}Pu *per liter for* $\frac{1}{8}$*-in. thick-0.2 wt % Gd plates on 1 in. centers.* (auth)

952 ELECTRIC FURNACE. Leikand, M. S.; Zakhmatov, A. Ya.; Shterman, S. M. (to Vsesojuzny Nauchno Issledovatelsky Proektnokonstruktorsky i Tekhnologichesky Institut Elektrotermicheskogo Oborudovania). *British Patent 1,301,256. 29 Dec 1972.* Filed date 22 Jul 1971. 5p.

An electric furnace suitable for burning toxic radioactive or *biological waste is described. The furnace described comprises* a refractory-lined body containing electric heating elements. The body of the furnace contains a shaft with ends protruding outside the body and having a drum mounted on it, consisting of a spirally wound sheet of metal provided with end plates. A housing located in the body is adapted for sealing the drum and provided with loading and ash discharge pipes, and ducts are provided in the shaft for the supply of air into the drum. A reversible rotation drive is *connected to the shaft for rotating the drum in one direction to mix* and crush the burning waste, and for reversing the drum to remove the burnt products. Half-discs may be provided on the inner surfaces of the end plates to control the direction of the air supply. Throttle valves may be provided to adjust the amount of supplied air. The loading pipe may be separated from the drum by a movable heat insulating screen. The design ensures high efficiency and complete burning, and is pressure-tight. (UK)

953 C.R.A.C. (CONSEQUENCES RADIOLOGIQUES d'un ACCIDENT DE CRITICITE) PROGRAM. Study of Criticality Accidents Occurring in Solution. Agaisse, R.; Barbry, F.; Bouly, J. C.; Lecorche, P.; Mangin, D.; Maubert, L.; Revol, H. (CEN de Saclay, Gif-sur-Yvette, France). Bull. Inform. Sci. Tech. *(Paris); No. 172, 3-27(Jul 1972). (In French).*

The C.R.A.C. program is used to study criticality accidents which could occur during the handling of fissile material in solution form and the radiological consequences of such accidents. Only the first aspect of the problem is discussed. The experimental system is described (core, assembly for preparing and decontaminating fissile solutions, assembly for the acquisition of information provided with analogue channels, a multiplexer, an analogue digital converter, a CII 90-10 calculator, and a memory). A power excursion experiment is described together with the means adopted to detect the radiations. The results obtained (power growth, doubling time, and fission number) are given. Practical results concerning the maximum number of fissions which could occur in various types of geometry are discussed. (FR)

Transportation

954 *TRANSPORTING RADIOACTIVE MATERIALS SAFELY.* Edgerton, J. H. Translog; 3: No. 8, 18-19(Aug 1972).

The safety record of shipments of fissile and radioactive materials is reviewed as well as regulations related to such shipments. Activities of the U. S. Army Transportation Engineering Agency (USATEA) related to assuring the safest transport of radioactive materials are described. USATEA has provided criteria for equipment and methods for transporting radioactive materials from Thule, Greenland to the US, materials from decommissioned research reactors, and radioactive wastes. (LCL)

955 NEUTRON SHIPPING CONTAINER, MODEL 4T (18 Jan 1971) (Engineering Materials). (California Univ., Livermore. *Lawrence Livermore Lab.). (CAPE-2331).*

27 drawings.

956 *LAW ON THE PEACEFUL USES OF NUCLEAR ENERGY AND THE PROTECTION AGAINST ITS DANGERS (ATOMIC ENERGY LAW).* pp v of Bundesimmissionsschutzrecht. Kommentar. Band 2. Feldhaus, G. (ed.). Wiesbaden, Ger.; Deutsches Fachschriften-Verlag (1971). (In German)

The complete text of the law enacted on December 23, 1959, and amended June 23, 1970, concerning regulations governing the licensing of nuclear installations is presented. These provisions relate to the import and export, transport, storage, and processing of nuclear fuels, as well as to liabilities, compensation, supervising authorities, and administrative aspects in connection with the operation of nuclear facilities. (GF)

PARTICLE ACCELERATORS

Design, Development, and Operation

Refer also to abstracts 1096, 1357, and 1456.

957 (CEAL-3063-5) SEMIANNUAL REPORT FOR THE PERIOD JANUARY 1-JUNE 30, 1972. Strauch, K.; Shurcliff, W. A. (Cambridge Electron Accelerator, Mass.). Dec 1972. Contract AT(30-1)-2076. 73p. Dep. NTIS.

In this period the first colliding beam experiment, which employed 2-GeV positrons and 2-GeV electrons was started with round-the-clock runs for eleven weeks. The number of 8-hour shifts devoted to development of beam storage techniques (116 shifts), operations of the BOLD detector (136 shifts), and maintenance, installation of new equipment, and unscheduled downtime (194 shifts) is indicated. The means by which the peak values of beam currents and luminosity were increased and also the means by which the reliability was improved, beam lifetime was increased, and the refilling time was shortened, thus providing greater long-term-average luminosity, are described. The design and completion of installation of the bypass on-line detector (BOLD) are described. The actual data-taking runs are described. During the course of the experiment the time-integrated luminosity was $(1.12 \pm 0.09) \times 10^{34}$ cm^{-2}, a total of 255 valid e^+e^- scattering events were recorded in the fiducial volume. The cross section for such events was found to be $(2.49 \pm 0.195) \times 10^{-32}$ cm^{-2}, which is to be compared with $(2.82 \pm 0.06) \times 10^{-32}$ cm^{-2} calculated from Q.E.D. Results on $\gamma\gamma$ events and multi-hadron events are expected to be available soon. The design and status of the magnetic on-line detector (MAGNOLIA), designed to be effective in the analysis of hadron events are described. Also, the completion of Synchrotron Radiation Beamrun 37½ to the new Synchrotron Radiation Room and the start of experimental programs there are discussed. The major publications in this period are listed. (auth)

958 (CONF-730310-36) MULTI-ACCELERATOR SYSTEM FOR HEAVY IONS. Hudson, E. D.; Lord, R. S.; Ludemann, C. A.; Mallory, M. L.; Martin, J. A.; Milner, W. T.; Mosko, S. W.; Stelson, P. H.; Zucker, A. (Oak Ridge National Lab., Tenn.). 1972. 5p. Dep. NTIS $3.00.

From 5th particle accelerator conference; San Francisco, California, USA (5 Mar 1973).

The accelerators for the new National Heavy-Ion Laboratory (NHL) being planned at Oak Ridge will provide beams of all ions from helium to uranium with energies ranging from 100 MeV/u for light ions to 10 MeV/u for the heaviest ions accelerated. The heart of the proposed accelerator system is a large 4 sector isochronous cyclotron of the separated sector type with an energy rating of 440 q^2/A MeV. Ions are to be injected into the large cyclotron from either a large tandem electrostatic accelerator or from the Oak Ridge Isochronous Cyclotron (ORIC). The ORIC will generally suffice as the injector up to the mass 160-180 range, beyond which use of the tandem is necessary. Beam intensities will range from 10^{13} ions/sec for 100 MeV/u oxygen to $\sim 2 \times 10^{12}$/sec for 10 MeV/u uranium ions. The beam emittance is expected to be less than 10 mm-mrad and the energy spread less than 0.1%. The large cyclotron uses auxiliary RF accelerating cavities operating at twice the main RF frequency to flattop the effective accelerating voltage waveform to thus increase the phase acceptance and reduce the energy spread of the beams. (auth)

959 (LA-UR-73-385) OPERATING RESULTS ON THE 800-MeV PROTON LINAC AT THE LOS ALAMOS SCIENTIFIC LABORATORY. Hagerman, D. C. (Los Alamos Scientific Lab., N. Mex.). 1972. Contract W-7405-eng-36. 9p. (CONF-730310-25). Dep. NTIS $3.00.

From 5th particle accelerator conference; San Francisco, California, USA (5 Mar 1973).

The operating parameters of the LAMPF linac are described; and the integrity of design, the tuning problem, the interim results, and future plans are discussed. (WHK)

960 (RHEL/R-267) NIMROD OPERATION AND DEVELOPMENT. Quarterly Report, October 1-December 31, 1972. Gray, D. E. (Rutherford High Energy Lab., Chilton (England)). Jan 1973. 18p. Dep. NTIS (U. S. Sales Only) $3.00. UK 25 pence.

The Nimrod beam was on for High Energy Physics Research for 91% of HEP scheduled operating time. Three experiments were completed in the fourth quarter of 1972 together with an extension to a bubble chamber proposal. Three other experiments continued. Some work on proton scattering radiography, using 7-GeV protons from Nimrod, is described. (auth)

961 (RHEL/R-268) PREDICTION OF INDUCED ACTIVITY LEVELS IN AND AROUND NIMROD. Hack, R. C. (Rutherford High Energy Lab., Chilton (England)). Jan 1973. 27p. Dep. NTIS (U. S. Sales Only) $3.50. UK 30 pence.

Comparisons are reported between measured and predicted levels of induced radioactivity for a number of irradiation conditions. Good agreement was found between experimental measurements and fairly simple methods of prediction developed at CERN. (auth)

962 (UCRL-74309) PULSED BEAM CAPABILITIES OF THE LIVERMORE CYCLOGRAAFF. Davis, J. C.; Anderson, J. D.; Freytag, E. K.; Rawles, D. R. (California Univ., Livermore. Lawrence Livermore Lab.). Mar 1973. 7p. (CONF-730310-22). Dep. NTIS $3.00.

From 5th particle accelerator conference; San Francisco, California, USA (5 Mar 1973).

The Livermore cyclograaff facility has been operational for experimental use since October 1971. Accelerator development has concentrated upon production of proton beams with burst length and repetition rates suitable for fast neutron time-of-flight work. Average target currents exceeding 1 μA are now available in pulsed beam mode over the nominal 1-27 MeV range of the combined machines. (auth)

963 (UCRL-Trans-1493) COLLECTIVE CYCLOTRON-GYROTRON. Kolomenskii, A. A. (Akademiya Nauk SSSR, Moscow. Fizicheskii Institut). Translated by G. Brodell from Preprint No. 141. 1972. 27p. Dep. NTIS $3.50.

The characteristics of a new modification for the collective acceleration of particles, called a gyrotron, are evaluated. This modification has some hypothetical advantages in comparison with the methods usually studied. The general idea of the gyrotron (collective cyclotron) consists of giving a closed space configuration to the electron beam and forcing it to manipulate as a whole, accomplishing a periodic motion; an electromagnetic field of a special type is used. A potential well for holding ions forms in each point of the beam and the beam effects these ions as a holding bar. Due to the beam moving as a whole and the ions slipping along the curve formed by the beam, the ions experience the action of a reaction force and increase their energy. The condition of the beam rotation can be achieved, for example, with the help of a rotating electromagnetic field. The study is limited to the examination of the field in a cylindrical resonator, although a case of spherical (or ellipsoidal) resonator, or a more complicated system can also be of interest. (WHK)

964 OPTIMUM SIZE OF A CYCLOTRON FOR MEDICAL APPLICATION. Chaudhri, M. A. (Islamabad Univ., Rawalpindi, Pakistan). Proc. Jap. Conf. Radioisotop.; No. 10, 212-217(Apr 1972).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

Generally speaking, the bigger the cyclotrons, the better they are for obtaining higher isotope yield, the more the detection sensitivity in charged-particle activation analysis, and the more intense and penetrating are the neutron beams for therapy. Using the method given by Chaudhri and empirically constructed excitation functions, the thick target yield of the isotopes which are produced by the proton, deuteron, and alpha bombardment of all elements from Z = 20 to 83 was calculated. Optimum energy seems to be approximately 12 to 14 MeV for the deuterons. The corresponding maximum energy for the protons, alphas, and He particles would be 24 to 28, 24 to 28, and 32 to 37 MeV, respectively. As a result, it is suggested that cyclotrons big enough to be able to produce a 12 to 14 MeV deuteron beam would be the optimum size from the cost as well as usefulness points of view. (JA)

965 VARIOUS CHARACTERISTICS OF 6 MeV LINEAR ACCELERATOR. Ishida, T.; Matsumiya, A.; Karashima, H.; Yoshikawa, Y.; Tamazumi, Y. (Hyogo-Ken Cancer Center, Kobe, Japan). Hyogo-Ken Gan Senta Nempo; No. 5-6, 33-55(Mar 1971). (In Japanese).

The operating parameters of a linac x-ray medical facility are described. Isodose curves for radiotherapy are given, and the performance for x-ray diagnosis is discussed. (WHK)

966 COLLIDING ELECTRON-POSITRON BEAMS IN A SYNCHROTRON. Ado, Yu. M.; Belovintsev, K. A.; Bessonov, E. G.; Cherenkov, P. A. Tr. Fiz. Inst., Akad. Nauk SSSR; 54: 130-148(1971). (In Russian).

The results of research on a method for obtaining colliding electron-positron beams in a synchrotron are reviewed. There is a detailed discussion of questions related to the effect of a

time-varying, driving magnetic field and a low injection energy level on the main parameters of the particle storage process, i.e., radiation damping of oscillation amplitudes, beam lifetime, and storage rate. A description is given of the results of experiments for studying the particle storage process and obtaining colliding electron–positron beams on the FIAN (Physics Institute imeni P. N. Lebedev, Academy of Sciences USSR) 280-MeV synchrotron. There is also a description of work done in the USSR and abroad to use the counterbeam method for synchrotrons with an energy of ~1 GeV or more, including the Italian 1.5-GeV Adone positron storage ring, the 6-GeV Cambridge electron synchrotron project in the United States, and the cascade storage system developed by staff members of the Photomeson Process Laboratory and Accelerator Laboratory of FIAN. The particle storage process is divided into two stages in the cascade system: (1) particle storage in a booster synchrotron, and (2) transfer of electron and positron beams to the main synchrotron at intervals equal to the booster particle storage time. Another variant of the cascade system permits a significant increase in the electron beam conversion ratio through the use of high-energy electrons accelerated in the main synchrotron. (JPRS)

967 METHOD OF REGULATING CAPTURE EFFICIENCY IN A SYNCHROCYCLOTRON. Danilov, V. I.; Safonov, A. N.; Smirnov, V. I. (to Joint Inst. of Nuclear Research). Russian Patent 269,367. 15 Feb 1971. Filed date 12 Dec 1966. (In Russian).

A method is proposed for regulating capture effectiveness in the acceleration mode in a synchrocyclotron. The procedure is based on changing the magnetic field of the accelerator. As a distinguishing feature of the patent, the intensity of the output beam is increased by azimuthal variation of the magnetic field, and the average value of the field is regulated by varying the ring current flowing through the turns of a winding around the pole. (JPRS)

968 TREND OF THE MEDICAL CYCLOTRON. Karasawa, T. (Inst. of Physical and Chemical Research, Wako, Japan). Proc. Jap. Conf. Radioisotop.; No. 10, 474-475(Apr 1972). (In Japanese).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

The relation between magnet weight (W tons) and maximum accelerated energy (T MeV) of a cyclotron is, under specified conditions, $T \propto W^{\frac{1}{3}}$, and the cost of the cyclotron may be proportional to the magnet weight. The cyclotron contributes to medical care in two ways, irradiation and production of radioisotopes. Radiation therapy is comprised of proton irradiation and by fast-neutron irradiation. The proton energy for treatment is decided by the depth of irradiated parts from the skin. The fast-neutron energy needs to have a half thickness equivalent to the depth of irradiated parts from the skin. Many radioisotopes are produced with the medical cyclotron. The most important factors to be taken into consideration are selection of targets and types of nuclear reaction. When ^{11}C, ^{13}N, and ^{15}O are produced by a (d,n) reaction, a deuteron energy of 5 MeV is high enough. The targets must not melt by heat. Therefore, various techniques for improving the method of cooling the targets are studied. (JA)

969 CLINICAL USEFULNESS OF MEDICAL CYCLOTRON. Arimizu, N. (Chiba Univ., Japan). Proc. Jap. Conf. Radioisotop.; No. 10, 471-473(Apr 1972). (In Japanese).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

Medical cyclotrons are used in diagnosis and medical treatment. The cyclotrons for diagnosis are mainly utilized to produce radionuclides and for medical treatment; they contribute to radiotherapy by the irradiation of particles and neutrons. Characteristics of the radionuclides for diagnosis are summarized as follows; decay time is rather short, many kinds of the nuclides are required, some kinds of nuclides must be supplied in large quantity, and they must be supplied without any discontinuity. In Japan, at present, an experimental cyclotron produces only a small amount of radioisotopes for clinical research. The accelerating energy of the medical cyclotrons is limited by the scale of those cyclotrons. Therefore, radiation that can reach deeply into the body is restricted to fast neutrons and electrons. Electrons are accelerated by betatrons, and the medical cyclotrons produce fast neutrons. (JA)

970 CIVIL ENGINEERS BUILD WORLD'S LARGEST PROTON ACCELERATOR. Alexander, W. D.; Warner, M. E.; Rohrer, E. P.; Pages, R. E. Civil Eng. (N. Y.); 42: No. 10, 77-82 (Oct 1972).

The design and construction of the NAL Synchrotron is described. Topics include surveying, soil analysis, the booster ring, shielding against radiation, the main ring, the power supply, the water supply, and project management. (WHK)

971 DEVICE FOR ACCELERATING CHARGED ATOMIC PARTICLES INCLUDING A PAIR OF HIGH FREQUENCY RESONATORS. Wierts, D.; Boomsma, P. (to U. S. Philips Corp.). U. S. Patent 3,718,865. 27 Feb 1973. Priority date 29 Apr 1970, Netherlands. 8p.

An electric high-frequency resonator for accelerating charged atomic particles, comprising a first hollow conductor, a second hollow conductor extending within the first hollow conductor, a third hollow conductor extending within the second hollow conductor and a fourth hollow conductor extending within the third hollow conductor is described. The second and third hollow conductors and the first and fourth hollow conductors are connected respectively to form first and second waveguides for the propagation of high-frequency waves. Input coupling means are employed to connect the interposed first and second waveguides in series thereby providing increased electrical length characteristics for the propagation of high-frequency electric waves without increasing the structual length of the resonator. (Official Gazette)

972 CLINTON P. ANDERSON MESON PHYSICS FACILITY (LAMPF). Rosen, L. (Los Alamos Scientific Lab., NM). Proc. Nat. Acad. Sci. U.S.A.; 70: No. 2, 603-610(Feb 1973).

The design, construction, and planned uses of the LAMPF are briefly described. (TFD)

973 NEW MACHINE FOR INTERMEDIATE ENERGY NUCLEAR PHYSICS: THE 3 GeV SYNCHROTRON SATURNE. Thevenet, B.; Vienet, R. (CEN de Saclay, Gif-sur-Yvette, France). J. Phys. (Paris), Colloq.; No. 5, 173(1972). (In French).

The characteristics of Saturne and the proton and deuteron beams extracted are briefly reviewed. Such beams have recently been used for the study of nuclear physics reactions. (FR)

Auxiliaries and Components

974 (BNL-17705) MAGNETIC BEAM POSITION MONITOR. Claus, J. (Brookhaven National Lab., Upton, N. Y.). 1973. 3p. (CONF-730310-30). Dep. NTIS $3.00.

From 5th particle accelerator conference; San Francisco, California, USA (5 Mar 1973).

The theory and use of the magnetic beam position monitors in use in the AGS injection line are described. These are strictly linear devices of very low impedance with a rise time of the order of 1 μsec. They do not require electronics close to the device and have been constructed to withstand considerable radiation. Their construction is simple and not critical. (auth)

975 (BNL-17736) HEATING ON SUPERCONDUCTING SPLITTER MAGNET BY HADRON. Lee, Y. Y. (Brookhaven National Lab., Upton, N. Y.). 12 Mar 1973. 6p. Dep. NTIS $3.00.

The radiation heating of superconducting septum magnets by diffraction scattered proton at 30 GeV/C was calculated. Some suggestions to shield the magnet for use as splitter magnet in the AGS are presented. (auth)

976 (LA-UR-73-386) CENTRAL CONTROL ROOM MAN-MACHINE INTERFACE AT THE CLINTON P. ANDERSON MESON PHYSICS FACILITY (LAMPF). Hartway, B. L.; Bergstein, J.; Plopper, C. M. (Los Alamos Scientific Lab., N. Mex.). [nd]. 3p. (CONF-730310-24) Dep. NTIS $3.00.

From 5th particle accelerator conference; San Francisco, California, USA (5 Mar 1973).

The control system for the Clinton P. Anderson Meson Physics Facility (LAMPF) is organized around an on-line digital computer. Accelerator operations are conducted from the Central Control Room (CCR) where two identical but independent operator consoles provide the man-machine interface. The evolution of the man-machine interface from the initial concepts of a computer control system is traced. Special emphasis is given to the human factors which influenced the development. The way in which an operator interacts with the system is illustrated by a description of an accelerator operating sequence. (auth)

977 (LA-UR-73-387) COMPACT PROGRAMMABLE CONTROL PANEL FOR COMPUTER CONTROL SYSTEMS. Hartway, B. L. (Los Alamos Scientific Lab., N. Mex.). [nd]. 5p. (CONF-730310-23). Dep. NTIS $3.00.

From 5th particle accelerator conference; San Francisco, California, USA (5 Mar 1973).

The Card Programmable Function Button Panel is basically a manual data entry device used for computer program assignment and binary control. However, it has the ability to be reassigned in over one thousand different configurations by changing a computer-read program card which also provides labeling of the panel's control buttons and indicator lights. The multiple assign-

ment capability is accomplished by an optically-read ten-bit binary code on the program card. The panel is packaged in a 3-wide 8¾ inch high AEC Standard Nuclear Instrument Module (NIM). The front panel contains 30 control-button/indicator-light pairs which are labeled by the dollar-bill-sized program cards. The cards are made of a thin white plastic with a special writing surface. The recessed indicator-light matrix thus provides separate backlighting through each of the button-adjacent printed partitions of the over-laying program cards. Binary code bit-locations are printed across the bottom edge of the card, and the cards are encoded by punching out the appropriate code using a standard hand punch. The panel contains all the electronics necessary for lamp drivers, lamp test, lamp dimmers, as well as the logic for the registration, validation, reading, and transmission of the card's binary code to the computer. Separate electronics provides for button-switch debouncing, encoding, key-roll-over protection, and indicator-status memory. Electronic and mechanical construction details are reviewed as well as a brief description of the panel's use on the operator's control consoles at the Clinton P. Anderson Meson Physics Facility of the Los Alamos Scientific Laboratory. (auth)

978 (LA-UR-73-388) DIGITAL FILTER DESIGN FOR ACCELERATOR DATA AND CONTROL SYSTEMS. Machen, D. R. (Los Alamos Scientific Lab., N. Mex.). 1972. 3p. (CONF-730310-26). Dep. NTIS $3.00.

From 5th particle accelerator conference; San Francisco, California, USA (5 Mar 1973).

The acquisition of real-time analog signals by a digital computer for the purpose of data reduction, supervisory control, or optimization has become a common technique in today's particle accelerator laboratories. Signal variables of interest most generally contain unwanted noise spectra or are in need of bandwidth limiting prior to use by a computer algorithm. The recursive digital filter (RDF) is a useful method for generating algorithms through which quantized analog-signal sequences are altered with respect to their frequency spectrum. Rather simple filter algorithms can be developed that correspond to commonly used analog filters in both step-response and frequency-response characteristics. The development of the RDF state-equations is discussed along with an example of filter algorithm design applicable to accelerator development and control problems at NAL. In addition, the attenuation and phase characteristics of the example RDF are compared to those of the counterpart analog filter. (WHK)

979 (LBL-1387) ADVANCEMENTS IN CONTROL TECHNOLOGY AT THE BEVATRON. Evans, D. M.; Guggemos, J. R.; Kilgore, R. L.; Rondeau, D. J. (California Univ., Berkeley. Lawrence Berkeley Lab.). Mar 1973. Contract W-7405-eng-48. 4p. (CONF-730310-33). Dep. NTIS $3.00.

From 5th particle accelerator conference; San Francisco, California, USA (5 Mar 1973).

Several new developments in control technology at the Bevatron are described. The "learned curve" concept of accelerator rf frequency modulation control is explained as it applies to increased performance of radial positioning of the beam, and as it provides for open loop operation of the accelerator with low intensity ion beams. A major innovative step has been taken in the utilization of sampled data techniques in a multi-channel digital closed loop power supply regulator in the new 750 keV Ion Gun. Pulsed quadrupole magnets in the drift tubes of the 50 MeV Linac are continuously monitored by a fast digital scanner to provide radiation interlocks as well as comprehensive diagnostics with an eye toward detection of incipient failures. A new logically oriented interlocking and chain control system is described. (auth)

980 (LBL-1390) SUPERCONDUCTING BEAM-TRANSPORT MAGNETS FOR THE BEVATRON. Gilbert, W. S.; Meuser, R. B.; Voelker, F.; Kilpatrick, R. A.; Eaton, W. F.; Toby, F. L.; Acker, R. C. (California Univ., Berkeley. Lawrence Berkeley Lab.). Mar 1973. Contract W-7405-eng-48. 6p. (CONF-730310-34). Dep. NTIS $3.00.

From 5th particle accelerator conference; San Francisco, California, USA (5 Mar 1973).

Two superconducting dc beam transport magnets being installed on a secondary particle beam of the Bevatron are described. They are a dipole (bending magnet) and a quadrupole doublet (focusing magnet). Both have clear room-temperature aperture diameters of 8-in. iron flux return yokes and will be cooled by a Cryogenic Technology, Inc. Model 1400 refrigerator. Nominal field strengths are 40 kG and 6 kG/in., respectively. The main parameters and drawings of the magnets are given. (WHK)

981 (LBL-1703) SUMMARY OF INTERNATIONAL PROGRESS ON SUPERCONDUCTING MAGNETS. Gilbert, W. S. (California Univ., Berkeley. Lawrence Berkeley Lab.). Mar 1973. Contract W-7405-eng-48. 8p. (CONF-730310-35). Dep. NTIS $3.00.

From 5th particle accelerator conference; San Francisco, California, USA (5 Mar 1973).

Superconducting pulsed magnets for use in high field synchrotrons and storage rings and dc dipoles and quadrupoles for use in beam transport lines are reviewed. Operating and construction plans for the immediate future are presented. (auth)

982 (RHEL/R-265(Pt. 2)) IMPREGNATION OF SUPERCONDUCTING WINDINGS WITH EPOXY RESINS. Part 2. Resin Data. Middleton, A. J.; Hey, P. D.; Colyer, B. (Rutherford High Energy Lab., Chilton (England)). Dec 1972. 48p. Dep. NTIS (U. S. Sales Only) $4.50. UK 50 pence.

Mechanical properties data are given for a number of epoxy resins which have been tested, both at room temperature and at liquid helium temperature. (auth)

983 COPPER-STABILIZED SUPERCONDUCTING CONDUCTOR FOR THE NATIONAL ACCELERATOR LABORATORY BUBBLE CHAMBER MAGNET. Larson, W. L.; Randall, R. N.; Wong, J. CDA-ASM Conference Paper No. 030/2. New York; Copper Development Association, Inc. (1972). 10p.

The 13-ft diameter magnet is constructed from 136,000 ft of Cu-stabilized superconducting Nb–Ti alloy. The properties of the Cu (high resistance ratios, thermal conductivity and ductility) are discussed and the process for fabricating the conductor is described. (Metals Abstr.)

984 OSNOVY ZASHCHITY USKORITELEY. (Principles of Accelerator Shielding). Zaitsev, L. N.; Komochkov, M. M.; Sychev, B. S. Moscow; Atomizdat (1971). 400p.

A study on the problems of calculating the parameters of designing and utilizing accelerator shielding is presented. The study deals with interactions between particles and matter, the propagation of radiation in matter, methods of calculating the shielding parameters, the types of radiation in accelerators, experimental studies of processes in shielding, induced radioactivity, composition of shielding and selection of materials, planning of buildings and shielding, and construction of shielding. (JPRS)

985 MULTICHANNEL DELAY CABLE SYSTEM FOR CRT DISPLAY OF FAST SIMULTANEOUS SIGNALS. Ogata, A. (Nagoya Univ., Japan); Horikoshi, G. Nucl. Instrum. Methods; 108: No. 3, 615-617(1973).

A delay cable system is described which displays several simultaneous signals in the nanosecond region in a single trace on an oscilloscope. The system is used in the study of the energy spectrum of an injection beam of an electron ring accelerator. (auth)

Ion Sources and Injection and Extraction Systems

986 (BNL-17678) MULTITURN INJECTION INTO THE CONVERTED AGS. Claus, J.; Brown, H. N.; Month, M.; van Steenbergen, A. (Brookhaven National Lab., Upton, N. Y.). 1971. 5p. (CONF-730310-31). Dep. NTIS $3.00.

From 5th particle accelerator conference; San Francisco, California, USA (5 Mar 1973).

A description is given of the status and performance of the AGS multiturn injection system. Experimental results are presented and compared with analytical predictions. Details are given concerning on-line computer emittance-acceptance matching and multiturn stacking in either the "horizontal only" mode or "horizontal-vertical" mode. In addition, a description is given of specific components such as the "horizontal-vertical" inflector and the emittance measurement device. (auth)

987 (IFVE-SEF-71-30) POSITIVE PARTICLE PRODUCTION BY 70 GeV PROTONS. Gorin, Yu. P.; Denisov, S. P.; Donskov, S. V.; Kotov, V. I.; Petrukhin, A. I.; Prokoshkin, Yu. D.; Seleznev, V. S.; Stoyanova, D. A.; Khodyrev, Yu. S.; Shuvalov, R. S. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1971. 8p. (In Russian). INIS.

The results of the first measurement of the yield of positive particles (π^+, K^+ mesons, protons, and deuterons) on the IHEP 70-GeV accelerator are reported. (tr-auth)

988 (JINR-P9-6972) SLOW EXTRACTION OF THE BEAM FROM THE JINR SYNCHROPHASOTRON (SYSTEM CALCULATION). Vasilishin, B. V.; Issinskii, I. B.; Kulakova, E. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 25p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.25.

The calculation of the slow extraction system, based on the

resonance $\nu_x = 2/3$, is described and its parameters are given. The removal of the influence of the accelerator fringing field nonlinearities allows one to transport the beam without significant phase distortions. Calculated efficiency is about 96%. (auth)

989 (LA-UR-73-328) SATELLITE MINICOMPUTER: A PRACTICAL SOLUTION TO ACCELERATOR CONTROL. Machen, D. R.; Potter, J. M. (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract W-7405-eng-36. 2p. (CONF-730310-9). Dep. NTIS.

From fifth particle accelerator conference; San Francisco, California, USA (5 Mar 1973).

The value of using more intelligent interface devices in large facilities controlled by a central computer control system is indicated, and the operational satellite-minicomputer system at the LAMPF injector complex is briefly described. (WHK)

990 DEVICE FOR FEEDING THE DEFLECTING PLATES OF A RING ACCELERATOR. Barabash, L. Z.; Kryzhanovskii, O. I.; Lebedev, P. I. Russian Patent 307,542. 5 Aug 1971. Filed date 31 Mar 1970. (In Russian).

Rapid discharge of the deflecting voltage from the plates of an electrostatic inflector is extensively used for single-revolution injection in cyclic accelerators. An impulse thyratron is ordinarily used for discharging the inflector capacitance. In the initial part of the acceleration period, the deflection voltage across the inflector must be held close to the zero level. Ordinarily for this purpose the commutating thyratron is artificially maintained in the ignited conductive state through the entire acceleration period. This mode considerably cuts down the life of the thyratron and reduces the reliability of the injection system. A method of eliminating this disadvantage is proposed. An electronic switch is added to the primary circuit of the high-voltage rectifier of the inflector supply system to disconnect the rectifier supply immediately after voltage discharge across the inflector. Throughout the entire process of rectifier disconnection, the ignited state of the commutating thyratron is maintained by a low-voltage RC circuit connected through a decoupling diode. (JPRS)

991 OBSERVATION OF THE BLOCKING EFFECT AFTER $^6Li(n,t)^4He$ REACTIONS WITH THERMAL NEUTRONS. Biersack, J. P.; Fink, D. (Hahn-Meitner Inst. fuer Kernforschung, Berlin). Nucl. Instrum. Methods; 108: No. 2, 397-399(1973).

The emission of p, t, or α-particles, following the capture of thermal neutrons in crystalline targets, may be used to observe blocking or channeling effects. The $^6Li(n,\alpha)T$ reaction is utilized to demonstrate this for LiF crystals containing 3.7 atom % ^6Li. A first experiment with a cellulose acetate foil as detecting device, and a second experiment with a miniaturized goniometer and surface barrier detector inside a reactor beam tube, revealed clear axial and planar blocking patterns. (auth)

Ion Optics and Field Calculations

Refer also to abstract 818.

992 (CEA-CONF-2199) STATUS REPORT ON THE SACLAY ELECTRON RING EXPERIMENT. Nakach, A. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). [nd]. 7p. (CONF-720952-4). Dep. NTIS (U. S. Sales Only) $3.00.

The Van de Graaff accelerator which was previously the injector for Saturne is being converted for studying the formation and compression of an electron ring. The status of the conversion project is briefly outlined and the main parameters of the Van de Graaff, the gun, the beam line, the compressor, and injection are listed. (WHK)

993 (JINR-P9-6930) APPLICATION OF AZIMUTHAL MAGNETIC FIELD TO COLLECTIVE ION ACCELERATOR. Bonch-Osmolovskii, A. G.; Preizendorf, V. A.; Reshetnikova, K. A. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1973. 16p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The recent results on the use of the azimuthal magnetic field in the collective ion accelerator are reviewed. Based on a specific scheme of the accelerator where such a field is formed both on the phase of the ring compression and along its acceleration path, there are shown the physical advantages achieved by this: improvement of the formation process, of the stability, and of the ring alignment. (auth)

994 (UCRL-Trans-1491) STABILITY OF THE FOCUSED AZIMUTHAL-HOMOGENEOUS ELECTRON BEAM. Grigorev, V. P.; Didenko, A. N. Translated by G. Brodell from Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 7, 32-37(1971). 18p. Dep. NTIS $3.00.

Using the method of a self consistent field, the stability of a focused azimuthally uniform beam of electrons moving in a cylindrical resonator located in a focusing magnetic field is calculated. Dispersion equations are derived, the harmonics of possible oscillations are determined, and the increments of resonance instability are found. (tr-auth)

995 (UCRL-Trans-10683) NUMERICAL MODELING OF TWO DIMENSIONAL QUASI-STATIONARY ELECTROMAGNETIC FIELDS. Doinikov, N. I. 1972. Translation of NIIEFA Preprint B-0169. 25p. Dep. NTIS $3.25.

The statement of two-dimensional (plane-parallel and axially symmetric) quasistationary problems of electrodynamics in the absence of distributed charges is discussed. On the basis of the method of nets an algorithm for calculating the electromagnetic field of eddy currents on a computer is obtained, providing the solution of a self-consistent problem in the region of finite dimensions with allowance for the parameters of the external circuit. The method is illustrated on specific examples. Examples of problems having practical importance include the determination of the perturbations of the field from induced currents in the metallic chamber of a charged-particle detector, problems of the effectiveness of inductive energy accumulators, the establishment of additional losses, etc. The process of the penetration of an external homogeneous magnetic field with a linear growth front into conducting rods of rectangular cross section is investigated. (auth)

996 (UJF-2921-F) ION MOTION IN THE CENTRAL REGION OF THE CYCLOTRON. Bejsovec, V.; Hrda, A.; Kuzmiak, M. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderne Fyziky). Nov 1972. 8p. Dep. NTIS (U. S. Sales Only) $3.00.

The equations for ion motion in the cyclotron are given in cylindrical coordinates and a method for their solution is described. (auth)

997 NUMERICAL CALCULATIONS OF THE ELECTRIC FIELDS AROUND THE HOOP STRUCTURE OF VAN DE GRAAFF ACCELERATORS. Eastham, D. A. (Daresbury Nuclear Physics Lab., Eng.). Nucl. Instrum. Methods; 108: No. 3, 593-597(1973).

Electric field strengths have been evaluated at the surface of circular and oval hoops in the geometry of a Van de Graaff accelerator. The results are compared with the analytical results of Boag (Proc. IEEE IV 100, No. 51 (1953)63) and it is shown that the use of oval hoops is only effective for small axial voltage gradients. (auth)

Storage Rings

998 (BNL-17660) ISABELLE e-p OPTION. Chasman, R.; Voss, G. (Brookhaven National Lab., Upton, N. Y.; Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). 1972. 5p. (CONF-730310-29). Dep. NTIS $3.00.

From 5th particle accelerator conference; San Francisco, California, USA (5 Mar 1973).

During the ISABELLE preliminary design study it became clear from the response of the high-energy physics community that the addition of an electron ring to the proposed 200-GeV colliding proton beam facility would be very attractive. It was felt that with the capability of this ring to reach an energy of 15 GeV the already wide range of experimental possibilities of ISABELLE would be greatly extended. Basic design features for such an electron ring have been worked out. Lattice parameters, rf system, injection scheme and characteristics of its interaction with one of the proton rings are presented. The resulting luminosity was estimated to range from $\approx 10^{33}$ to $\approx 0.5 \times 10^{32}$ cm^{-2} sec^{-1} for c.m. energies from 65 to 109 GeV. (auth)

999 (BNL-17661) SUPERCONDUCTING MAGNET MODELS FOR ISABELLE. Dahl, P. F.; Damm, R.; Jacobus, D. D.; Lasky, C. (Brookhaven National Lab., Upton, N. Y.). 1973. 5p. (CONF-730310-32). Dep. NTIS $3.00.

From 5th particle accelerator conference; San Francisco, California, USA (5 Mar 1973).

The development program for the superconducting magnets of the Intersecting Storage Accelerators is described. The dipole magnet design is of the cos θ type and employs a wide ribbon conductor. Magnetic measurements are compared with calculations which include the effects of conductor magnetization and iron saturation. Calculations of the harmonics due to the magnet ends are also presented along with estimates of the effect of the shape of the outer boundary of the iron shield on the field and the degree of interaction between the magnets in the two rings. The conductor is a metal-filled braid woven from 186 wires each containing 400 filaments. A precision molding technique has been developed which assures accurate placement of the turns and could be used for semi-mass production. The iron cores are laminated and assembled in a special way to eliminate the axial differential expansion between the coil and the core. Correction coils for the 3θ and 5θ terms are built into the bore tubes. These coils are necessary to correct the small (10^{-3}) harmonics produced by con-

ductor magnetization at low field and iron saturation at high fields. (auth)

1000 (BNL-17735) RANDOM ERRORS IN ISA DIPOLES. Dahl, P. F. (Brookhaven National Lab., Upton, N. Y.). 6 Mar 1973. 3p. Dep. NTIS $3.00.

The sensitivity to random positional errors in conductor location was investigated in the case of two dipoles of the cos θ type, one of 8-cm aperture and one of 10-cm aperture. (auth)

1001 (BNL-17752) INCOHERENT TUNE SHIFTS FOR THE ISA. Month, M. (Brookhaven National Lab., Upton, N. Y.). 21 Mar 1973. 6p. Dep. NTIS $3.00.

The vertical tune shifts due to space charge and due to images are computed for two possible sets of ISA magnet parameters. A circular geometry corresponds to a design suitable for a synchrotron with very high field magnets, ~40 kG. This is referred to as the cold case. A second possibility is a larger radius synchrotron with low field magnets, ~13 kG. The main feature in this case, referred to as the warm case, is a very small gap height in the magnets. Parallel plate geometry is assumed. The warm case, as presented here, is clearly unacceptable, leading to an incoherent ν-shift of almost 3 full units. Given the following three assumptions: 1. that the injection energy is 30 GeV so that the AGS can be used as an injector to the ISA; 2. that the tune be about 20 in order that the transition energy be sufficiently below the injection energy; and 3. that the circulating current not be less than 15 A, so that sufficient luminosity be attainable when the beams of the intersecting rings collide; then, with those three assumptions, a simple relation connecting the tune shifts for the cold and warm cases is obtained. It is concluded that, in order to bring the image tune shift for the warm case to an acceptable value, the radius must be decreased and the magnet gap height must be increased. In fact, the required changes tend to lead the design strongly in the direction of the original cold case. (auth)

1002 (BNL-17758) ISABELLE DESIGN STUDY. Mills, F. E. (Brookhaven National Lab., Upton, N. Y.). 1972. 3p. (CONF-730310-37). Dep. NTIS $3.00.

From fifth particle accelerator conference; San Francisco, California, USA (5 Mar 1973).

Some highlights of the ISABELLE design study are briefly discussed, and some of the unresolved problems are considered. Topics include intersection regions, the vacuum system, and non-linearities. (WHK)

1003 (KFTI-71-30, pp 1-12) STUDY OF ATTENUATION OF SYNCHROTRON OSCILLATIONS OF TWO PLASMOIDS IN SINGLE SEPARATRIX WHEN INTERACTING WITH RESONATOR. Koba, I. I.; Kononenko, S. G.; Lobzov, L. D.; Reprintsev, L. V.; Shenderovich, A. M. (Physical-Technical Inst., Kharkov). 1971. (In Russian).

An experimental investigation of the attenuation of coherent oscillations is described for a single separatrix while interacting with a passive resonator. Quantitative time estimates of the diminution of the amplitude of coherent oscillations fell in the same order of magnitude as the theoretical values of the times of attenuation of oscillations of two δ-form bundles. The investigation was conducted on a storage device for 70 MeV electrons at the Physico-Technical Institute of the Academy of Sciences. Ukrainian SSR. (tr-auth)

1004 (KFTI-71-30, pp 13-22) DESIGN FEATURES AND BASIC CHARACTERISTICS OF THE ACCELERATING STORAGE DEVICE OF THE PHYSICO-TECHNICAL INSTITUTE. Koba, I.I.; Mocheshnikov, N. I.; Shenderovich, A. M.; Yartsev, P. A. (Physical-Technical Inst., Kharkov). 1971. (In Russian).

The construction and operating characteristics of an acceleration facility is described in connection with a storage device for electrons at the Physico-Technical Institute of the Academy of Sciences, Ukrainian SSR. The acceleration facility was completed in the form of a segment of a two-conductor long line and represents a multi-resonance low-Q oscillation system. (tr-auth)

1005 (KFTI-71-30, pp 23-30) rf SUPPLY APPARATUS OF ACCELERATING STORAGE DEVICE FOR STORAGE PHYSICS EXPERIMENTS. Koba, I. I.; Mocheshnikov, N. I.; Shenderovich, A. M.; Yartsev, P. A. (Physical-Technical Inst., Kharkov). 1971. (In Russian).

Radiotechnical and radioelectronic apparatus was designed for the study of the electron storage device at the Physico-Technical Institute, the Academy of Sciences, Ukrainian SSR. Its purpose was the fast interception of two bundles from separatrices in connection with attenuation, both in the presence and the absence of a passive resonator. Particle injection into the storage device uses the method of expanding separatrices. The effect of enlargement of the phase width of a bundle was studied during an increase of the stored current. (INIS)

1006 CERN INTERSECTING STORAGE RINGS. Johnsen, K. (CERN, Geneva). Nucl. Instrum. Methods; 108: No. 2, 205-223 (1973).

The Intersecting Storage Rings (ISR) have been constructed to give very high center-of-mass energies in proton-proton collisions by providing high-energy proton beams that collide head-on. By having 26 GeV protons in each beam one obtains 52 GeV center-of-mass energies. In order to achieve similar energies with ordinary particle accelerators, energies of 1500 GeV would be needed. The main problem with such colliding beam devices is to accumulate sufficiently intense circulating beams that useful interaction rates are obtained. The design aim was a luminosity per intersection region of 4×10^{30} cm^{-2} s^{-1}. This was reached by the end of 1972 and under good experimental conditions. After less than two years operation the ISR have therefore established themselves as an important high energy physics tool. The article describes the construction and the present performance with a few concluding remarks on the physics programme. (auth)

1007 BEAM FEEDBACK ELECTRONICS FOR THE SPEAR STORAGE RING. Pellegrin, J. L. (Stanford Univ., CA). Nucl. Instrum. Methods; 108: No. 2, 365-373(1973).

The two beams of the 2 GeV Stanford electron-positron storage ring can exhibit, under certain modes of operation, coherent oscillations which have a rate of growth proportional to the beam current. Since this rate is much slower than the machine revolution frequency, it is possible to produce damping by means of negative feedback, the beam itself being part of the feedback loop. Three systems have been built, two for the damping of transverse oscillations at the betatron frequency, and one for the damping of longitudinal oscillations at the synchrotron frequency. The electronics for these systems require wide band high power amplifiers and nanosecond circuitry. (auth)

1008 COLLIDING BEAMS VERSUS BEAMS ON STATIONARY TARGETS: COMPETING TOOLS FOR ELEMENTARY PARTICLE PHYSICS. Panofsky, W. K. H. (Stanford Linear Accelerator Center, CA). Proc. Nat. Acad. Sci. U. S. A.; 70: No. 2, 611-618 (Feb 1973).

The development and advantages of colliding beams for high-energy particle physics are reviewed. (TFD)

1009 CERN INTERSECTING STORAGE RINGS (ISR). Johnsen, K. (CERN, Geneva). Proc. Nat. Acad. Sci. U. S. A.; 70: No. 2, 619-626(Feb 1973).

A general description of the CERN ISR including design and layout, operating parameters, and experimental capabilities is presented. (TFD)

Experimental Facilities

Refer also to abstract 1357.

1010 (BNL-17676) SUPERCONDUCTING 8° BENDING MAGNET SYSTEM. Allinger, J.; Danby, G.; DeVito, B.; Gibbs, R.; Hsieh, D.; Jackson, J.; Prodell, A.; Raag, A. (Brookhaven National Lab., Upton, N. Y.). [nd]. 5p. (CONF-720513-15). Dep. NTIS $3.00.

From applied superconductivity meeting; Annapolis, Maryland, USA (1 May 1972).

A superconducting magnet system has been designed and is being constructed to bend the primary proton beam from the Alternating Gradient Synchrotron to the new North Experimental Area at Brookhaven National Laboratory by 8°. The design of this system is based on extensive evaluation of materials involved and on detailed model studies. Details of the conductor and conductor tests, magnet circuit, magnet and cryostat construction and assembly, and refrigerator and transfer lines are given. (auth)

1011 (BNL-17679) SUPERCONDUCTING NIOBIUM DEFLECTORS. Aggus, J. R.; Bauer, W.; Giordano, S.; Hahn, H.; Halama, H. J. (Brookhaven National Lab., Upton, N. Y.). 1973. 3p. (CONF-730310-27). Dep. NTIS $3.00.

From 5th particle accelerator conference; San Francisco, California, USA (5 Mar 1973).

The study of S-Band superconducting niobium cavities is being carried out for application to long-pulse rf beam separators in the momentum range of the AGS, whereas, X-Band frequencies are being considered for the NAL accelerator. Results for a 5-cell S-band prototype are: a peak field of 410 G, corresponding to an equivalent deflecting field of over 2 MV/m, and a loss improvement factor of 2×10^5. The fabrication and post-fabrication treatments are described. Perturbation measurements to determine deflector parameters are summarized. A new type of mode stabilizer is suggested. A 7-cell X-Band deflector is under construction. (auth)

1012 (BNL-17740) BROOKHAVEN LINAC ISOTOPE PRODUCER (BLIP). Richards, P.; Lebowitz, E.; Stang, L. G. Jr. (Brookhaven National Lab., Upton, N. Y.). 1973. 21p. (CONF-730309-6; SM-171/38). Dep. NTIS $3.25.

From symposium in new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973).

The BLIP serves as a beam stop and utilizes the excess beam capacity of a new 200-MeV proton linac that injects protons into the 33-GeV AGS to produce radioisotopes for use in nuclear medicine. The BLIP beam line and target facility are described and the method of production, expected yields, and potential applications, are listed for producing ^{123}I, ^{127}Xe, ^{52}Fe, ^{201}Tl, ^{97}Ru, and ^{82}Rb. (WHK)

1013 (CEA-CONF-2227) MAGNET SYSTEM FOR NUCLEAR SPECTROMETRY AT 1.7 GeV/c AND HIGH RESOLUTION. Birien, P. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1972. 3p. (CONF-720908-35). Dep. NTIS (U. S. Sales Only) $3.00.

From 4th international conference on magnet technology; Upton, New York, USA (19 Sep 1972).

The status of the experimental magnet system at Saturne is described. The system consists of the analyzing magnets, quadrupoles and sextupoles; spectrometer I (for the energy resolution $\Delta E/E = 10^{-4}$ and solid angle 3×10^{-3} sr); and spectrometer II (for the momentum resolution 5×10^{-4}, solid angle 2×10^{-2} sr, and momentum range ±20%. (WHK)

1014 (CERN-Trans-72-19) FOCUSING DEVICE FOR NEUTRINO EXPERIMENTS. Voronov, V. I.; Danil'chenko, I. A.; Rzaev, R. A.; Samoilov, A. V. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). Nov 1972. Translation by R. Luther of IFVE-OP/SPK-70-93. 59p. Dep. NTIS (U. S. Sales Only) $5.00.

A description of the magneticoptic system that consists of linear-focusing units is given. Proceeding from performed analysis, an optimum system consisting of parabolic lenses has been chosen. This system may be applied in the IHEP neutrino experiments. The calculated ratio and neutrino spectra are given. (auth)

1015 (CERN-Trans-72-20) SYSTEM OF SLOW TARGETING OF AN ACCELERATED BEAM ON INTERNAL TARGETS IN THE IHEP 70 GEV ACCELERATOR. Gridasov, V. I.; Kardash, A. A.; Kozlov, K. M.; Kurnaev, O. V.; Lapin, V. V.; Lobanov, S. V.; Moizhes, L. L.; Myznikov, K. P.; Naumov, A. A. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). Dec 1972. Translation by R. Luther of IFVE-SKU-70-57. 18p. Dep. NTIS (U. S. Sales Only) $3.00.

A feedback system using a target beam current detector at the Serpukhov Synchrotron is described for targeting the accelerated beam during the flattop of the accelerator's magnetic cycle. (WHK)

1016 (COO-3130-166) SEPARATED ANTIPROTON BEAM WITH MOMENTUM TAGGING UP TO 2.4 GeV/c. Guerriero, L.; Lanou, R. E. Jr.; Marx, M.; Posa, F.; Rosenson, L.; Thornton, R. K. (Brown Univ., Providence, R. I. Dept. of Physics). Jun 1972. Contract AT(11-1)-3130. 19p. Dep. NTIS $3.00.

The low-energy separated beam 5B of the AGS at Brookhaven National Laboratory was modified to include a "tilted picket-fence" hodoscope which provides a momentum resolution of better than 0.5% full width. (auth)

1017 (LA-5222-MS) MECHANICAL DESIGN OF THE LAMPF LOW-ENERGY PION CHANNEL. Fulton, R. L. (Los Alamos Scientific Lab., N. Mex.). Mar 1973. Contract W-7405-eng-36. 6p. Dep. NTIS $3.00.

A pion channel has been designed and nearly completed that will provide a good quality, high-intensity pion beam of energies up to 300 MeV. Important channel features are a vertical bend plane, close alignment tolerances, short channel length, and remote handling near the production target. These features influenced the mechanical design of the magnets, support and alignment, collimation system, vacuum system, and shielding. (auth)

1018 (LNF-72/98) ULTRAVIOLET SPECTROSCOPY USING SYNCHROTRON RADIATION. Balzarotti, A.; Bartolini, L.; Bianconi, A.; Burattini, E.; Grandolfo, M.; Habel, R.; Piacentini, M. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 15 Nov 1972. 17p. Dep. NTIS (U. S. Sales Only) $3.00.

The radiation emitted by the 1.1 GeV synchrotron of the Frascati National Laboratories has been utilized as a source of extreme ultraviolet light for physical experiments. The main features of this source are described and the experimental equipment built to perform absorption measurements on solids in the photon energy range 50 to 220 eV is analyzed. The absorption spectra of various metal thin films are presented and discussed. (auth)

1019 (LNF-72/99) PROGRESS OF THE MONOCHROMATIC GAMMA PROJECT AND PRELIMINARY EXPERIMENTAL PROGRAM. Capitani, G. P.; De Sanctis, E.; Faini, S.; Guaraldo, C.; Malvano, R.; Ricco, R.; Sanzone, M.; Scrimaglio, R. (Comitato Nationale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 17 Nov 1972. 48p. (In Italian). Dep. NTIS (U. S. Sales Only) $4.50.

The present status of the project and the proposed preliminary experimental program for producing monochromatic γ rays at 60 to 300 MeV at the Frascati linac are described. The optics of the transport channel for the positron beam are described, and the various elements of the magnetic channel are illustrated. The characteristics of the gamma beam and the relevant monitoring systems are reported. Physical problems associated with the beam are discussed, and the preliminary experimental program is outlined. (tr-auth)

1020 (UJF-2899-F) MEDIUM SIZE POLARIZED PROTON TARGET. Burget, J.; Odehnal, M.; Petricek, V.; Sacha, J.; Tichy, R. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderne Fyziky). Dec 1972. 67p. Dep. NTIS (U. S. Sales Only) $5.50.

A medium-sized polarized proton target is described in detail. This target was installed in 1968 at the Van de Graaff accelerator of the Institute of Nuclear Physics at Rez. It is intended to be used in an experiment on polarized neutron scattering by polarized protons. In 1966 a similar medium-sized polarized target was described by a group at Los Alamos Scientific Laboratory (P. J. Bendt, J. J. Malanify, T. R. Roberts, and J. E. Simmons, Phys. Rev. Lett., 17: 481(1966)). A detailed description of the cryogenic part of the target and of the EPR and NMR spectrometers is given, and a detailed discussion of the procedure of polarization measurements is included. The target was operated in a field of 18 kG and a temperature of 1.2°K. The proton polarization in the LMN-crystal (10 × 10 × 0.75 mm) used was about ±50%. (auth)

1021 SIMPLE BEAM CHARGE MONITOR FOR NEUTRON GENERATORS. Loebenstein, H. M.; Gazit, Y. (Soreq Nuclear Research Centre, Yavne, Israel). Nucl. Instrum. Methods; 108: No. 2, 387-388(1973).

Due to an energy compensating effect, a counter set at a backward angle can be used to monitor the deuteron beam charge composition in a neutron generator. (auth)

1022 COMPUTER SYSTEM FOR MULTIPARAMETER MEASUREMENTS IN NUCLEAR PHYSICS. Harms-Ringdahl, L.; Sztarkier, J. (Research Inst. for Physics, Stockholm). Nucl. Instrum. Methods; 108: No. 3, 557-569(1973).

An on-line system for acquisition and analysis of experimental data from accelerators is described. The goal of the design has been a flexible and mobile system, which permits the performance of experiments at different accelerators at a distance from the computer. The system is designed to give an event-by-event record of an experiment on magnetic tape, provide initial analysis during the experiment and final analysis into 49k channels and with display of spectra. The system is based on a medium size computer with equipment especially constructed for this purpose. Examples of in-beam experiments measuring γ-γ coincidences and γ-t distributions are given. (auth)

1023 TARGET-HOLDER AND VACUUM CHAMBER FOR CYCLOTRON ISOTOPE PRODUCTION. Thain, E. (CSIR, Pretoria). Nucl. Instrum. Methods; 108: No. 3, 571-572(1973).

The design is described of a target-holder and vacuum chamber used in the production of radioisotopes in a cyclotron. (auth)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

Cosmic Radiation

Refer also to abstract 464, 539, 541, and 542.

1024 QUANTITATIVE INVESTIGATION OF THE SOLAR MODULATION OF COSMIC-RAY PROTONS AND HELIUM NUCLEI. Garrard, T. L. Pasadena, CA; California Inst. of Tech. (1973). 232p. University Microfilms Order No. 73-7288.

Thesis (Ph. D.).

The differential energy spectra of cosmic-ray protons and He nuclei were measured at energies up to 315 MeV/N using balloon- and satellite-borne instruments. These spectra are presented for solar quiet times for the years 1966 through 1970. The data analysis is verified by extensive accelerator calibrations of the detector systems and by calculations and measurements of the production of secondary protons in the atmosphere. (Diss. Abstr. Int., B)

1025 SPATIAL AND TEMPORAL VARIATIONS OF COSMIC RAYS IN THE SOLAR SYSTEM IN THE LIGHT OF NEW DATA ON RADIOACTIVITY OF METEORITES. Lavrukhina, A. K. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Geokhimiya; No. 1, 11-21(Jan 1973). (In Russian).

On the grounds of a comparison of data on the content of radioactive isotopes with different half-life periods in meteorites with different orbits with theoretical values, conclusions of principal importance about the temporal and spatial distribution of galactic cosmic rays have been drawn. It is shown that the region of their modulation lies at a distance of 1.9 ± 0.1 AU. The region of modulation extends at least up to 12° over the ecliptic. Data on the energetic spectrum of unmodulated galactic cosmic rays have been obtained. It has been determined that the intensity of galactic cosmic rays is constant in the region from 2 to 4 AU. The modulation region changes in inverse relation on the intensity of solar spots. No temporal variations of unmodulated galactic cosmic rays for the last million of years have been revealed. Periodical changes of this intensity for the last billion of years with a minimum in the range of 300 to 600 10^6 years ago are assumed. (auth)

1026 MEASUREMENT OF SUPER HEAVY NUCLEI IN THE PRIMARY COSMIC RAY BY USING SOLID STATE TRACK DETECTORS, X RAY FILM, AND NUCLEAR EMULSION PLATES. Ito, K. (Rikkyo Univ., Tokyo); Yanagimachi, T.; Doke, T.; Miyajima, M.; Okamoto, H. pp 129-140 of Large Balloon Symposium, 1971. Tokyo; Tokyo Univ. (1972). (In Japanese)

From large balloon symposium; Tokyo, Japan (13 Mar 1972).

Spectra of heavy charged particles in primary cosmic rays were measured to obtain information concerning synthesis of elements in stars. Preliminary experiments were carried out with x-ray films. Stacks of film were carried by a balloon to a height of 30.5 km for 7 hours 50 min. The stacks were composed of plastic films of 50 × 40 cm and x-ray films. Four nuclear emulsion plates were also used to investigate correlation with the x-ray films. Calibration curves for nuclear charge were obtained for the plastic films by using fission fragments. Particle detection efficiency of the x-ray films was studied with the help of the nuclear emulsion plates, and it was found that the nuclear charge of $Z \geq 20$ could be observed. The efficiency was estimated to be 100% for $Z \geq 35$. Velocity of particles was estimated from the blackness of track on the x-ray films. Determination of the position of a heavy ion track with $Z \geq 30$ was performed. This determination was carried out by etching the plastic films with NaOH solution. Since there was some ambiguity in the result, the etching process is still under study. (JA)

1027 PROJECT OF OBSERVATION OF SHORT PERIOD VARIATION OF COSMIC RAY. Kodama, M. (Inst. of Physical and Chemical Research, Wako, Japan). pp 195-198 of Large Balloon Symposium, 1971. Tokyo; Tokyo Univ. (1972). (In Japanese)

From large balloon symposium; Tokyo, Japan (13 Mar 1972).

A project is under way to observe time variations of cosmic rays. Purposes of the observation are to study power spectra and the remarkable spike of specific frequency, and to make comparison with I.M.F. spectrum. Detectors to be used are four plastic scintillators of 1 m × 1 m. The Pfotzer maximum, where intensity of total cosmic-ray components increases by 2 orders in comparison with the value at the Earth, is used to increase counting rate. The counting rate of 7×10^6 count/min is expected at the level of 150 g/cm^2. Observation of 6 min frequency variation is expected. A small balloon of 2,000 m^3 is enough to carry the detector system. Data are transmitted by FM/FM method. Low-level flight is incompatible with long time flight. A level of 50 mb seems to be proper height. It is necessary to observe atmospheric pressure at the time of the measurement of the cosmic-ray count. An ionization gauge with a radioactive source is useful to measure the pressure. (JA)

1028 OBSERVATION OF HIGH ENERGY PRIMARY ELECTRONS. Taira, T. (Kanagawa Univ., Yokohama, Japan); Nishimura, J.; Matsuo, M.; Niu, K.; Mikumo, E. pp 173-180 of Large Balloon Symposium, 1971. Tokyo; Tokyo Univ. (1972). (In Japanese)

From large balloon symposium; Tokyo, Japan (13 Mar 1972).

A trial was made to obtain the exact intensity of the spectra of high-energy primary electrons with emulsion chambers. The emulsion chambers were used for the determination of energy of the primary electrons by observing electron showers produced by the primary electrons. The chambers were composed of alternate emulsion plates and lead plates piled. Property of the particles detected was identified by tracks. Size of the chambers was 20 cm × 25 cm × 68 mm. Several x-ray films were inserted between the emulsion and lead plates to detect the electron showers with more than several hundred GeV of energy. Flight of balloons carrying the emulsion chambers was performed once every year since 1968. Observed gamma-ray intensity was compared with the intensity of μ mesons observed on the ground, and showed good agreement. This agreement showed that the method to identify the gamma ray and to determine its energy is reasonable. Ratio of the gamma-ray intensity to the electron intensity increased with energy. This result shows that the electron spectra do not increase as the gamma-ray spectra. Accuracy of the energy determination was examined, and it was confirmed that the error was within 10%. Spectra of the primary electrons are shown. The intensity of electrons decreases exponentially with the energy. The exponent of the spectra was 3.6. The result was compared with those by other groups. Agreement was not so good. (JA)

1029 MEASUREMENT OF ULTRA HIGH ENERGY PRIMARY NUCLEAR COMPONENT. Saito, T.; Noma, M.; Taneichi, H.; Sugimoto, H.; Sato, Y. pp 190-194 of Large Balloon Symposium, 1971. Tokyo; Tokyo Univ. (1972). (In Japanese).

From large balloon symposium; Tokyo, Japan (13 Mar 1972).

A preliminary experiment is to be carried out on the measurement of ultra high-energy primary nuclear component with an emulsion chamber. The experiment to be performed is exposure of an emulsion chamber of 1 m × 1 m in size and of about 600 kg weight for more than 15 hours. As a preliminary experiment, flight of a few small-size emulsions of about 100 kg is planned. It is expected to measure protons and helium nuclei of 10^{14} eV and heavy particles of 10^{13} eV. The emulsion chamber is separated in three parts. The first part is an emulsion of 400 μm thickness, and the charge of incident particles is determined with this part. The second part is a sandwich of 50 μm emulsion and carbon plates. Energy of the incident particles is determined at the second part. Angular distribution of the particles evaporated by nuclear collision is used for the determination of energy, and the accuracy is within 30%. The third part is a sandwich of 50 μm emulsion and lead plates, and used for the selection of events. Detection of the high-energy events is performed by finding cascade events. Detection efficiency is 100% for nuclei having charge more than 6 and energy more than 1 TeV/nucleon. (JA)

1030 PROJECT FOR THE MEASUREMENT OF ENERGY DISTRIBUTION OF PRIMARY COSMIC RAY BY USING A SUPERCONDUCTING MAGNET AND A LIQUID Xe DETECTOR. Doke, T. (Waseda Univ., Tokyo); Miyajima, M.; Hirabayashi, M.; Kita, I.; Takahashi, T. pp 204-209 of Large Balloon Symposium, 1971. Tokyo; Tokyo Univ. (1972). (In Japanese).

From large balloon symposium; Tokyo, Japan (13 Mar 1972).

An experiment is proposed to measure the energy distribution for each nuclear charge in the high-energy range by using a detection system with a liquid Xe proportional counter and a superconducting magnet. The liquid Xe detector has been studied to improve accuracy of position determination to ±10 μm from ±100 μm. The position detector system was designed with four pairs of the liquid Xe multi-wire proportional counter. A pair of detectors is arranged in perpendicular position. A dE/dx counter is inserted between the first and the second pairs of detectors. Magnetic field is applied to a space between the second and the fourth pairs of detectors. Detection area of the system is 50 cm × 50 cm. Weight of the magnet must be less than 400 kg, because it is carried by a balloon. Field intensity of the magnet seems to be most economical in case of about 20 kg. The magnet is a split solenoid type cooled by liquid helium. Energy ranges to be observed by this system are estimated to be 10 to 3400 GeV/N for protons, 5 to 1700 GeV/N for helium, 5 to 1200 GeV/N for particles of 16 ≤

$Z \leq 19$, and 5 to 1000 GeV/N for $Z \geq 20$. Total cost for the project is also estimated. (JA)

1031 OBSERVATION OF COSMIC GAMMA RAY BY USING A BALLOON. Danjo, A. (Niigata Univ., Japan); Hayakawa, S.; Ikeda, M.; Kasahara, I.; Makino, F. pp 168-172 of Large Balloon Symposium, 1971. Tokyo; Tokyo Univ. (1972). (In Japanese).

From large balloon symposium; Tokyo, Japan (13 Mar 1972).

Cosmic gamma rays were observed with a detector which was equipped with an active collimator and an active shutter to limit the direction of observation. A 3″ϕ × 3″ NaI (Tl) crystal was used as an energy spectrometer. The active collimator counter was composed of a 470ϕ × 500 plastic scintillator and four RCA-8055 photomultipliers. The spectrometer was shielded from low-energy x rays with 2 mm Sn and 1 mm Pb sheets. The active shutter counter was composed of a 3″ϕ × 2″ NaI (Tl) and an RCA2060 photomultiplier. Solid angle of the detector was obtained by Monte Carlo calculation. Pulses from the energy spectrometer were analyzed in 64 channels, pulses from the shutter counter in 32 channels. The active collimator counter detected pulses of higher than 50 keV. Flight of the balloon was performed on May 8, 1971, for 1 hour 45 min at a height of 5 mb. Data were analyzed by grouping into three energy ranges (110 to 160 keV, 160 to 360 keV, and 360 to 1100 keV). A component of the primary gamma ray was recognized in the energy range of 110 to 160 keV. Gamma-ray flux of the primary component, gamma rays due to the atmosphere, and a decay constant in relation to the atmospheric pressure were obtained. It was hard to observe the primary component in the ranges of 160 to 360 keV and 360 to 1100 keV. Upper limit of the primary flux was obtained. Background count was not reduced in the present experiment in comparison with a former experiment, though size of the present active collimator was twice as large as the former one. (JA)

1032 OBSERVATION OF GALACTIC GAMMA-RAY BY USING A Ge(Li) DETECTOR. Nakagawa, S.; Tsukuda, M.; Okudaira, K.; Hirashima, Y.; Yoshimori, M. (Rikkyo Univ., Tokyo). pp 162-165 of Large Balloon Symposium, 1971. Tokyo; Tokyo Univ. (1972). (In Japanese).

From large balloon symposium; Tokyo, Japan (13 Mar 1972).

Gamma-radiation was observed with a high-resolution Ge(Li) detector to study the energy spectra of low-energy cosmic rays. The detector was a 30 cc Ge(Li) detector, and its resolving power was about 8 keV for 0.511 MeV gamma rays. Detection efficiency multiplied by the geometrical factor of the detector was 1.6 cm^2 for the full energy peak of 0.511 MeV, and 0.1 cm^2 for the double escape peak of 4 MeV. Electronic parts were separated from the cooling system of the detector to avoid cooling. Output pulses were analyzed with a 512 channel pulse-height analyzer, and transmitted to the Earth. Range of the measurement was 2 to 5 MeV through a high-energy amplifier system, and 300 to 700 keV through a low-energy system. A balloon carrying the detector was released on September 30, 1971. The spectra of high-energy gamma rays was observed during upward and horizontal flight. An expected double escape peak due to $^{12}C(p,p'\gamma)$ was not seen. The upper limit of flux was estimated to be 1×10^{-3} cm^{-2} sec^{-1}. Altitude variation of low-energy photons was observed. A component of galactic 0.511-MeV gamma rays could not be observed. (JA)

1033 MEASUREMENT OF HEAVY PARTICLES AND ALPHA PARTICLES IN COSMIC RAY. Imai, K.; Kondo, I. (Nagoya Univ., Japan). pp 141-144 of Large Balloon Symposium, 1971. Tokyo; Tokyo Univ. (1972). (In Japanese).

From large balloon symposium; Tokyo, Japan (13 Mar 1972).

Measurement of the intensity of alpha particles was performed with a balloon to study the modulation mechanism in interplanetary space. The balloon was in flight at 5 mb for about 11 hours. Operation of the detection system seemed to be normal. Detectors were acrylic Cherenkov detectors associated with scintillators. Direction of the path of the particles was determined by the scintillators. Pulses from the scintillators were analyzed with mini pulse-height analyzers. Position of peaks in pulse height distribution of single charged particles was observed at times to find the performance change of amplifiers and other circuit elements. The scintillators were tilted to increase the directional uniformity of detection. Time variation of the pulse height was not seen. Noise on the pulse height spectra and drift of the peaks, however, made the analysis hard. (JA)

1034 ELECTRON COMPONENT OF COSMIC RAYS. I. Spatial Distribution and Energy Spectrum. Bulanov, S. V.; Dogel, V. A.; Syrovatskii, S. I. Cosmic Res. (USSR) (Engl. Transl.); 10: No. 4, 478-488(1972).

Translated from Kosm. Issled.; 10: No. 4, 532-544(1972).

The boundary value problem is solved for the equation describing the process of convective-diffusion electron transport in the Galaxy with allowance for energy losses and boundary absorption. The results of numerical calculations are presented for models of a flattened halo with sources (supernovae) distributed in a thin disk near the galactic plane. The structure of the electron energy spectrum on various energy intervals is discussed. It is shown that for energies above ~5 GeV the spectrum observed near the Earth is in satisfactory agreement with the model for which the exponent of the galactic electron injection spectrum $\gamma_0 = 2.2$ and the thickness of the halo is ten times greater than the thickness of the source region 2b = 200 to 300 pc. In this case the decrease of the spectrum exponent in the region of energies of a few GeV and below should be partly attributable to solar modulation. (auth)

1035 RESULTS OF MEASUREMENTS OF THE INTENSITY OF COSMIC RAYS BY THE AUTOMATIC STATION VENERA-7. Vernov, S. N.; Vakulov, P. V.; Getselev, I. V.; Gorchakov, E. V.; Grigorov, N. L.; Ignat'ev, P. P. Cosmic Res. (USSR) (Engl. Transl.); 10: No. 4, 503-509(1972).

Translated from Kosm. Issled.; 10: No. 561-568(1972).

Results are presented of measurements of the intensity of low-energy cosmic rays, which were obtained during the flight of the "Venera-7" interplanetary station during the period from August 17 through December 15, 1970. Proton fluxes having energies of 1 to 5, 4 to 12, and above 30 MeV were recorded, as well as fluxes of electrons having an energy above 0.05 and 0.2 MeV. Three considerable increases in the intensity of cosmic rays in August, November, and December of 1970 are considered. (auth)

Stars

Refer also to abstract 1074.

1036 EARLY EVOLUTION OF STARS. I. Strom, S. E.; Strom, K. M. (Kitt Peak National Observatory, Tucson, AZ). Sky Telesc.; 45: No. 5, 279-282(May 1973).

A theoretical description of early stellar evolution is given. Observations of stellar objects are described. (WDM)

1037 POSSIBILITY OF A PHASE TRANSITION TO A PION CONDENSATE IN NEUTRON STARS. Barshay, S. (Univ. of Copenhagen); Vagradov, G.; Brown, G. E. Phys. Lett.; 43B: No. 5, 359-361(5 Mar 1973).

The possibility that a pion condensate may arise in an infinite nuclear medium as a consequence of the modification of the pion propagator due to isobar-hole and nucleon-hole excitations is considered. This does not seem likely in a system with N = Z at densities of less than 0.17 fm^{-3}, but does seem likely to occur at the densities encountered in the interior of neutron stars. A necessary neutron density of ≥0.38 fm^{-3} and a condensate energy density of ≥-0.25 MeV fm^{-3} are estimated. (auth)

1038 SHOCK WAVES THROUGH SELF-GRAVITATING GAS SPHERES. Chaturani, P. (Indian Inst. of Tech., Bombay). Indian J. Pure Appl. Math.; 3: No. 3, 379-383(May 1972).

The propagation of strong shock waves through the envelope of a generalized Roche model is studied. By using the method of characteristics analytic expressions for shock velocity and flow variables behind the shock are obtained. These expressions show that the effects of density distribution (density proportional to the square of the radial distance from the center) and self-gravitating force are of opposite nature. Due to this density distribution, an increase in radial distance leads to an increase in shock velocity, pressure, and particle velocity; and due to the self-gravitating force, an increase in the radial distance leads to a decrease in shock velocity, pressure, and particle velocity. Finally, it is concluded that for this model these expressions are such functions of radial distance r that the effects due to self-gravitating force start dominating for large values of r; and as a result, ultimately shock decays. (auth)

1039 SPECTRAL AND PHOTOELECTRIC OBSERVATIONS OF THE FLARE STAR AC + 39° 1214-608. Shakhovskaya, N. I. Izv. Krym. Astrofiz. Observ.; 45: 124-129(1972). (In Russian).

Photoelectric observations of this star in photometric system close to B showed the flare activity UV Cet-type. Seven weak flares were observed during the whole monitoring time. The equivalent widths of Ca II and H emission lines were obtained using six spectrograms with the dispersion 160 Å/mm. The relative intensities of these lines were also determined. Variations of the emission which were not caused by flares during the exposure time were found. Two possible causes of these variations may be suggested: 1) variations in the common state stellar chromosphere from one season to the other; 2) the slow decay of the emission lines after flares. (auth)

1040 VARIATIONS OF THE HYDROGEN BALMER LINES IN THE SPECTRUM OF SILICON AP-STAR CU VIR. Ryabchikova, T. A. Izv. Krym. Astrofiz. Observ.; 45: 146-151(1972). (In Russian).

The phase-variations of Balmer lines H_γ to H_{13} were examined in variable silicon Ap-star CU Vir (HD 124224). The variation of

W_λ during the period was found to be about 25%. The variations of $lg\ n_e$ determined by Unsold's method were irregular within the range of 0.1 and probably were caused by errors in the measurements of W_λ. The variations of profiles and W_λ of hydrogen lines can be accounted neither for variations of T_{eff} nor for that of n_e. The phase curves of hydrogen W_λ were shifted relative to the phase curves of light and color variations. (auth)

1041 QUANTITATIVE ANALYSIS OF β LYRAE SPECTRA. I. Variations of Some Hydrogen and Helium Lines. Skul'skii, M. Yu. Izv. Krym. Astrofiz. Observ.; 45: 135-145(1972). (In Russian).

Using spectrograms with dispersions 14 and 34 Å/mm in the regions 3600 to 4900 Å and 5400 to 6800 Å, respectively, contours of lines λ 3888 He I, H_δ, H_λ, λ 4471 He I, H_β, λ 5875 He I, and H_α were obtained in absolute units for different phases of the eclipsing variable β Lyrae. (auth)

1042 TiO ABSORPTION AND THE MAGNITUDES OF dM-STARS. Chugainov, P. F. Izv. Krym. Astrofiz. Observ.; 45: 130-134(1972). (In Russian).

The assumption is made that the magnitudes R_J, I_J (Johnson's system) of the red dwarf stars depend not only on the bolometric luminosities and the effective temperatures but also on the strength of TiO absorption bands. The anomalies of strength of TiO absorption may cause the observed dispersion in the positions of stars on the M_{RJ}, $(R-I)_J$-diagram. The observed differences of magnitudes $R_J-(102)$ and $I_J-(102)$ (the magnitudes (102) and color-indices (102, 65) are in Eggen's system) are compared with the computed differences for the case of blackbody radiation. Three stars, showing abnormally high TiO-absorption, possess the brightnesses R_J smaller than for the other stars with the same color-index (102, 65). This fact favors the assumption made above. The color temperature scale for the dwarf stars obtained by Eggen should be revised. (auth)

1043 POLARIZATION OBSERVATIONS OF NONSTABLE STARS AND EXTRAGALACTIC OBJECTS. I. Equipment, Method of Observation, and Reduction. Shakhovskoi, N. M.; Efimov, Yu. S. Izv. Krym. Astrofiz. Observ.; 45: 110(1972). (In Russian).

The new photon-counting polarimeter of the Crimean Astrophysical Observatory is intended for linear polarization measurements of extremely faint and rapidly changing objects. An analyzer (polaroid) continuously rotates with the rate of 33.3 revolutions per second. Three scalars counting pulses from photomultiplier are switched in step with the rotation of the analyzer. Each scalar counts pulses being proportional to the light intensity for the corresponding mean position of analyzer. The polarimeter is mounted at the Nasmith focus of the 2.6-m telescope. A computer is used to reduce the observations. Linear transformation of Stokes parameters is applied to reduce the observed instrumental parameters to their true values. Observations of standard stars are used to obtain the coefficients and transformation formulae—separately for different colors (U, B, V, R) and observational periods. From the analysis of the reduction coefficients the basic characteristics of the instrumental effects were estimated. Their wavelength dependences were obtained. Standard star observations showed the sufficient fitness of the accepted reduction procedure. The external errors of the Stokes parameters were found to be about 0.2%. (auth)

1044 POLARIMETRIC OBSERVATIONS OF NONSTABLE STARS AND EXTRAGALACTIC OBJECTS. II. EV Lac Flare Polarization. Efimov, Yu. S.; Shakhovskoi, N. M. Izv. Krym. Astrofiz. Observ.; 45: 111-117(1972). (In Russian).

Polarimetric observations of the flare star EV Lac were carried out in four different spectral regions. The flare of EV Lac on August 17, 1969, was measured polarimetrically in blue region. It was found that polarization of the EV Lac radiation at the different phases of the flare is the same as at the undisturbed state of the star. The wavelength dependence of the polarization was found. (auth)

1045 SPECTROGRAPHIC INVESTIGATION ON THE FLARE STAR YZ CMi IN JANUARY 1969. Gershberg, R. E. Izv. Krym. Astrofiz. Observ.; 45: 118-123(1972). (In Russian).

Results of spectral observations of the star YZ CMi which were carried out during its international photometric patrol are given. The quantitative spectral characteristics of the star were determined at the quiet state and during 5 flares. Equivalent widths and relative intensities of emission lines, depths of the absorption line λ 4227, and the values of intensity jumps at the limits of TiO molecular bands were obtained. During the flares a strong intensification of hydrogen and calcium emission lines was observed, the absorption features in spectra were veiled with continuum flare-radiation, and the Balmer decrement became more flattened. The enhanced calcium emission was discovered for many hours following the strong flares. (auth)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstract 543.

1046 EVOLUTION AND STRUCTURE OF H II REGIONS. Mansfield, V. N. Ithaca, NY; Cornell Univ. (1972). 208p. University Microfilms Order No. 73-7140.

Thesis (Ph. D.).

Through the use of numerical techniques accurate and extensive evolutionary models of H II regions have been made. Along with the hydrodynamics, the effects of stellar evolution, radiative transfer, and heating and cooling in the ionized and neutral gases have been included. In some of the calculations the evolution of the nebula was followed from the contraction of the exciting star on to the main-sequence all the way through to the post-main-sequence helium burning phase and the recombination of the H II region. The first two models considered have constant initial densities of $10cm^{-3}$ and 10^4cm^{-3} respectively. The next two models have gaussian initial density distributions with peak values of $17cm^{-3}$ and $1.7 \times 10^4cm^{-3}$ respectively superimposed on low density backgrounds. The fifth and sixth models have initial high density gaussian shells superimposed on low density backgrounds. The last model has an initial modified gaussian distribution of 10^5cm^{-3} superimposed on a low-density background. Interpreting the results of these models in the light of recent observations, some general conclusions are drawn concerning the evolution and morphology of H II regions and the H I clouds into which they evolve. The relevant time scales are found for several classes of H II regions. Compact H II regions are shown to have ionization ages of only 1 to 2×10^4 years. In the post-main-sequence phase many H II regions are seen to produce H II remnants—objects which should be observable and provide direct information about stellar evolution. An equilibrium model of Orion A is made by combining the detailed theory of ionization balance, radiative transfer, and clumping with extensive radio and optical results. It is shown that it is necessary to introduce nonuniform clumping in order to make the model predictions compatible with the observational results. Using the results of the evolutionary and equilibrium calculations, the nature and significance of the fine structure is discussed. (Diss. Abstr. Int., B)

1047 DETECTION OF HIGH ENERGY GAMMA RAYS FROM THE CRAB NEBULA PULSAR AND OTHER RESULTS OF THE FIRST BALLOON FLIGHT OF A NEW TYPE OF DETECTOR. Koch, D. G. Ithaca, NY; Cornell Univ. (1972). 89p. University Microfilms Order No. 73-5855.

Thesis (Ph. D.).

The performance and results of the first flight of a gas Cherenkov telescope used for the detection of high-energy cosmic gamma rays are considered. The flight was of short duration (2.3 hrs), but the detector has the advantage of large area (44,000 cm^2) and excellent rejection of non-gamma-ray events. This thesis, along with a previous thesis by the same author (Koch, 1971), form a complete unit, describing in detail a new type of cosmic gamma-ray detector from its initiation to completion and the obtaining of the first results. A description of the detector is also given by Albats et al., (1971). The principle of operation, salient features, and effective threshold of the detector are discussed and a program is described which was developed for pointing the telescope during later flights, the aspect solution for the first flight, that is, a determination of the position of the telescope axis on the celestial sphere throughout the flight and the analysis program used for placing the events on the sky and for generating an expected distribution of events on the sky, assuming the flux to be due only to the atmospheric background. The results are presented, including a discussion in detail of the statistical methods used to analyze the data. In only thirteen minutes' exposure to the Crab Nebula—the instrument measured a pulsed flux above 220 MeV of about $(1.5 \pm 0.7) \times 10^{-6}$ photons/cm^2-sec and determined an upper limit (with 95% confidence) of 1.1×10^{-5} photons/cm^2-sec for the non-pulsed flux. No significant flux above 120 MeV was seen from the galactic disk near the anti-center (upper limit 1.5×10^{-4} photons/cm^2-sec-rad). The atmospheric background above 120 MeV was found to be 1.1×10^{-3} photons/gm-sec-sr, consistent with a number of other determinations. (Diss. Abstr. Int., B)

1048 PHYSICAL MODELS OF RADIO OUTBURSTS IN EXTRAGALACTIC RADIO SOURCES. Peterson, F. W. Amherst, MA; Univ. of Massachusetts (1972). 168p. University Microfilms Order No. 73-6463.

Thesis (Ph. D.).

The adiabatic expansion model of Kellermann and Pauliny-Toth for radio variations in quasi-stellar objects and energetic galaxies is modified to incorporate a prolonged injection of particles into, and diffusion of particles out of the source causing the radio

variations. Least squares fits of the improved model to available data show that injection and diffusion must be considered as important as adiabatic expansion in the evolution of the source. Particle injection greatly improves the fit of the model to flux density data at high frequencies where the model grossly overestimates the observed flux density. In addition, injection removes the contradiction of having short inverse Compton scattering or synchrotron radiation lifetimes for electrons in a model which assumes the source to be evolving mainly by adiabatic expansion losses. Particle diffusion improves the fit of the model to the rapid fall off in flux density shown by the data. Radio outbursts in the QSO 3C 273 and the Seyfert galaxy 3C 120 provide flux density data for least squares fitting to the several injection and diffusion models examined. The data allows a conclusion to be made about the form of the injection, the best fitting one being chosen from among three considered. In calculating source properties such as total energy, magnetic field, and electron lifetimes, correction factors for relativistic expansion are included. The best fitting model leads to a conclusion about the possible origin of the radio variations: similarities between the source properties predicted on the basis of the improved model, and properties of supernovae, suggest that the variations may be radio recordings of supernova-like outbursts in QSOs and energetic galaxies. (Diss. Abstr. Int., B)

1049 SPECTRAL FLUX DENSITIES OF RADIO EMISSION FROM DISCRETE SOURCES AT 3.5 cm WAVE LENGTH. II. Gorshkov, A. G.; Moiseev, I. G.; Soglasnov, V. A. Izv. Krym. Astrofiz. Observ.; 45: 176-181(1972). (In Russian).

Results of measuring of flux densities of radio emission from 99 discrete sources at 3.5 cm wavelength are given. The observations were carried out with 22-m radiotelescope of the Crimean Astrophysical Observatory in May–June 1969. Data on the variability of radio emission from discrete sources and galaxy NGC 4278 are given. (auth)

1050 IONIZATION AND RELATIVE ABUNDANCE OF HYDROGEN AND HELIUM ATOMS IN THE GASEOUS FILAMENTS OF THE CRAB NEBULA. Golovatyi, V. V.; Pronik, V. I. Izv. Krym. Astrofiz. Observ.; 45: 152-161(1972). (In Russian).

Ionization of hydrogen and helium atoms for a gaseous filament embedded in L_c - radiation field is considered. Adopted parameters of field were close to those for several models of filaments having different electron density, abundance of helium, and optical depth beyond the Lyman limit. Different values of flux density and spectral index of ionizing radiation were also considered. The intensity ratios I (λ4471 He I)/I (H_β) and I (λ 4686 He II)/I (H_β), obtained for the model with helium abundance (He/H = 0.54), were in good agreement with observations. The observed differences of intensity lines λ4471 He I and λ4686 He II in the spectra of various filaments may be due to differences in the optical depth of these filaments. (auth)

1051 OBSERVATIONS OF VARIABLE RADIO SOURCES AT 8.2 mm. Efanov, V. A.; Zagatin, V. I.; Moiseev, I. G.; Tovmasyan, G. M.; Shteinshleger, V. B. Izv. Krym. Astrofiz. Observ.; 45: 172-175(1972). (In Russian).

The results of observations of radio sources 3C 84, 3C 273, and 3C 345 at 8.2 mm made in March 1970 at the Crimean Observatory with the 22 m radiotelescope in conjunction with a maser are presented. The fluxes of 3C 84, 3C 273, and 3C 345 were 29, 45, and 14 flux units (10^{-26} watt/m^2 · Hz), respectively. The calibration was made by observations of Jupiter. (auth)

1052 SOFT X-RAY STRUCTURE OF CASSIOPEIA A. Fabian, A. C.; Zarnecki, J. C.; Culhane, J. L. (University Coll., London). Nature (London) Phys. Sci.; 242: No. 115, 18-20(12 Mar 1973).

The supernova remnant Cas A was identified as an extended source of soft x rays. No evidence was found for the presence of a compact x-ray source. There are indications of nonuniformity in the x-ray surface brightness. (auth)

1053 FREQUENCY DEPENDENCE OF CIRCULAR POLARIZATION IN THREE COMPACT RADIO SOURCES. Seaquist, E. R. (Univ. of Toronto); Gregory, P. C.; Biraud, F.; Clarke, T. R. Nature (London) Phys. Sci.; 242: No. 115, 20-22(12 Mar 1973).

Simultaneous observations of circular polarization of 3C 138, 3C 279, and BL Lacertae (VRO 42.22.01) are reported at frequencies 1,666, 2,695, 8,085, and 13,500 MHz. In addition separate observations of the same sources made at other epochs at 3,240 MHz and 13,500 MHz are reported. The observations are used to examine the frequency dependence of the circular polarization of these three sources. (auth)

Solar Phenomena

1054 (COO-3577-2) MODEL FOR THE STEADY STATE INTERACTION OF THE SOLAR WIND WITH THE MOON. Catto, P. J. (Yale Univ., New Haven, Conn. Dept. of Engineering and Applied Science). 1972. Contract AT(30-1)-3943. 129p. Dep. NTIS $8.50.

Thesis.

The solar wind is a magnetized stream of charged particles emitted continuously by the Sun. The steady-state interaction of the solar wind with the Moon is modeled as a uniform, magnetized, quasi-neutral, collisionless, hypersonic, and hyper-Alfvénic flow of an electron–proton plasma past a perfectly ion absorbing, nonmagnetized sphere. The electron and proton densities and mean velocities are assumed to be equal nearly everywhere. Three different limits of steady-state equations are derived from the reduced Vlasov equations and the associated equations of the reduced description by both an ordering scheme that allows for the possibility of different scale lengths along the magnetic field B and along the center of mass velocity, and by an expansion in two small parameters that effectively measure the smallness of gradient B and electron thermal terms compared to a dominant term retained. The limit applicable to a particular problem is found to depend on the size of a dimensionless parameter which is the product of the parameter measuring the smallness of gradient B terms and the square of the ratio of the Alfvén to the ion thermal speeds. The less complicated of the two more appropriate limits is then applied to the steady-state Moon–solar wind interaction. A numerical solution of this limit is presented and discussed. A technique is presented whereby the three limits can be approximately extended to cases in which the electron thermal terms are comparable or larger than a dominant term retained. (auth)

1055 SOLAR-TERRESTRIAL PHYSICS. An Account of the Wave and Particle Radiations from the Quiet and the Active Sun, and of the Consequent Terrestrial Phenomena. Akasofu, S. I.; Chapman, S. The International Series of Monographs on Physics. New York; Oxford University Press (1972). 920p. $80.00.

An attempt is made to provide a comprehensive and unified review of the state of knowledge on solar influences on the Earth's upper atmosphere and electromagnetic environment. The subjects covered include: solar physics, solar wind, interplanetary space, cosmic rays, aeronomy, magnetospheric physics, the radiation belts, solar storms, interplanetary storms, magnetospheric storms, and auroral physics. (WDM)

1056 LIMB-BRIGHTENING OF THE SUN AT 8 mm. Eliseev, G. F. Izv. Krym. Astrofiz. Observ.; 45: 49-52(1972). (In Russian).

The distribution of the radio brightness across the solar disk at 8 mm is considered. The observations were made with the 22-metre radio telescope of the Crimean Astrophysical Observatory. The limb-brightening at 8 mm is revealed. The ratio of the disk-averaged brightness temperature to the central brightness temperature at 8 mm is calculated to be 1.16 ± 0.03. (auth)

1057 STRUCTURE OF THE NOISE STORM SOURCE ACCORDING TO OBSERVATIONS OF THE SOLAR ECLIPSE ON SEPTEMBER 22, 1968 AT 1.7 m. Yurovskaya, L. I. Izv. Krym. Astrofiz. Observ.; 45: 40-48(1972). (In Russian).

From the examination of the observations of the solar eclipse on September 22, 1968 at 1.37 m wavelength the noise storm source was found to consist of two regions separately observed on the solar disk; one was the region of the enhanced background continuum, another was the burst one. The dimensions of the enhanced background continuum region were 1.0 ± 0.2′ in eclipsing direction and 0.8 ± 0.2′ in the uneclipsing one. The dimensions of the region responsible for the bursts emission were about 13.6 and 7.6′ in the same directions. The observation with small time constant of recorder was favorable to define the more intensive central part of the burst region. Its dimensions were about 1.6 ± 0.8′ and 0.8 ± 0.8′ corresponding to eclipsing and uneclipsing directions. (auth)

1058 MODEL OF CHROMOSPHERE AND OF TRANSITION ZONE FROM CHROMOSPHERE TO SOLAR CORONA. Dubov, E. E. Izv. Krym. Astrofiz. Observ.; 45: 20-39(1972). (In Russian).

The model of chromosphere and of the transition zone from chromosphere to corona for quiet regions of the Sun is developed. The main feature of the model is the different dependence of electron temperature and electron density on the height upon the border and the midparts of supergranules, caused by different flux of mechanical energy in waves depending on the magnetic field strength. The mean value of density for different heights is given from eclipse observations. The dependence of temperature on

heights is chosen to fit the theoretical calculations of radio brightness for many wavelengths (from millimeters up to 1.5 meter) with the observed values. Thus the model obtained corresponds to observed solar emission in optical and radio regions of the spectrum. Besides this model accounts for the brightness distribution on spectroheliograms in H_α, K_{232}, and several uv lines. The solar emission flux calculated using this model for O VI 1032 Å line corresponds to the flux obtained with OSO IV for different regions of the chromospheric network. (auth)

1059 VELOCITY FIELD IN SOLAR ACTIVE REGIONS. Gopasyuk, S. I.; Tsap, T. T. Izv. Krym. Astrofiz. Observ.; 45: 14-19(1972). (In Russian).

The velocity fields at the different levels of the active regions were studied. The records of the radial velocities were made with the double magnetograph in the lines: Hα, Hβ, Hγ, Hδ, λ 5184 Å Mg I, λ 4227 Å Ca I, D_1 Na I, λ 4554 Å Ba II, λ 6103 Å Ca I, λ 5250 Å Fe I. It was found, that there was a good correlation between the velocities at the adjacent levels. The correlation decreased with the distance between the levels of line formation, and it disappeared for the velocities recorded in λ6103 Å–Hβ, λ5184 Å–Hα. The mean velocities (averaged over the whole area) increased with the height, exponentially. The mean velocities in the active regions and in the quiet regions were approximately the same. The tangential velocities in the active regions were higher than the vertical ones. (auth)

1060 LARGE-SCALE VELOCITY FIELDS, MAGNETIC FIELDS, AND BRIGHTNESS IN THE SOLAR ATMOSPHERE. Gopasyuk, S. I.; Tsap, T. T. Izv. Krym. Astrofiz. Observ.; 45: 3-13(1972). (In Russian).

A correlation between the radial velocities, magnetic fields, and brightness in active and undisturbed regions on the Sun was studied. The records of magnetic fields, radial velocities, and brightness were made in the λ 5250 Å Fe I, λ 6103 Å Ca I, H_α lines with the aid of double magnetograph. It was found that statistically the location of the largest longitudinal magnetic fields in the magnetic hills as well as the places of the maximal brightness in the active and quiet regions on the Sun coincide with the neutral lines on the radial velocity field. This correlation between the motions and magnetic fields holds true at the different levels in the solar atmosphere and at the different distances from center of the disc and even quite close to the limb. The fact that the radial velocities are zero in the regions of maximal longitudinal magnetic fields suggests probably that the gas moves across the magnetic lines of force. (auth)

1061 DEVELOPMENT OF THE OSO-6 HIGH-ENERGY NEUTRON DETECTOR AND CORRELATION OF MEASURED SOLAR NEUTRON FLUXES TO SOLAR FLARES. Young, F. University Park, NM; Univ. of New Mexico (1972). 219p. University Microfilms Order No. 73-8400.

Thesis (Ph. D.).

In an attempt to understand certain of the high energy processes that occur in the solar and terrestrial atmospheres and in the interplanetary medium a detector of 20- to 160-MeV neutrons was designed and constructed for OSO-6. Both the angle of incidence and the energy of the neutron are determined by a telescopic arrangement of four scintillation plastic counters which generates proton recoils and provides pulse heights for analyzing them. Results from a Monte Carlo calculation indicate that the overall average efficiency within an average angular acceptance of about 29° (FWHM) is approximately $(2.25 \pm 0.113) \times 10^{-4}$. This experiment was flown primarily to determine the energy spectrum and angular distribution of high-energy neutrons produced in the Earth's atmosphere, and to measure the high-energy neutron spectrum produced in the solar atmosphere. This particular work describes the development of the high-energy neutron detector and presents some results on the correlation of measured solar neutron fluxes with solar flare activity. An average solar neutron flux of $(0.461 \pm 0.254) \times 10^{-2}$ n/cm² sec for sixty optical solar flares with importance numbers ≥2B was measured. A flux of $(3.23 \pm 1.78) \times 10^{-2}$ n/cm² sec for a white-light flare was also noted. Theoretical neutron fluxes lie in the range from 2-70 n/cm² sec for optical and white-light flares. Furthermore, a solar neutron event occurred on the average 5.55 hours following the occurrence of an optical flare. This value differs markedly from theoretical estimates of 5 to 60 minutes. The discrepancy in the measured and theoretical neutron fluxes suggests a lack of basic understanding of mechanisms leading to neutron production at the Sun. (TSS) (Diss. Abstr. Int., B)

1062 CONDITIONS IN THE EARLY SOLAR SYSTEM, AS INFERRED FROM METEORITES. Anders, E. (Univ. of Chicago). pp 133-156 of From Plasma to Planet. Elvius, A. (ed.). New York; John Wiley and Sons, Inc. (1972).

The traditional view that the meteorites and planets originated by solid grains condensing and accreting in a neutral gas has been challenged by Arrhenius and Alfvén in that they propose that condensation took place from a plasma. Meteoritic evidence in support of the models is discussed. (W.D.M.)

1063 OBSERVATION OF THE FINE STRUCTURE OF SOLAR SURFACE. Moriyama, F.; Hirayama, T.; Shimizu, I.; Hamana, S.; Tokuya, A. (Tokyo Univ.). pp 76-81 of Large Balloon Symposium, 1971. Tokyo; Tokyo Univ. (1972). (In Japanese)

From large balloon symposium; Tokyo, Japan (13 Mar 1972).

A preliminary experiment was performed, in order to take movies of monochromatic images in white or H α(6563Å) to investigate the fine structure of solar surface. Instruments were installed in a gondola under a balloon of 5000 m³. The instruments comprised a main telescope with an objective of 800 mm focal length, focussing of which was performed by command; a photoelectric tracing apparatus equipped at the top of the main telescope to correct direction of the optical axis of the objective; a camera to take direct images of the Sun by command; a telemeter apparatus having three channels, two of which were used for the determination of the direction and measurement of incident light, and one for the transmission of twenty kinds of data; and command apparatus for the control of the balloon, for the pointing of the telescope, for focussing, for driving the camera, and for the on and off of a mirror to watch TV from the ground. The balloon was released on September 14, 1971, and was in horizontal flight at the height of 26 km for about 5 hours. The focussing and the pointing of the telescope were carried out by looking at the TV image, and 250 frames of the images of the sun were taken during the flight. Action of command and telemetry was normal. Temperature transmitted by telemetry was 19 ± 5°C, except at the place of direct exposure. Trouble arose sometimes in the pointing action of the telescope. Some images taken by the camera are shown. (JA)

1064 OBSERVATION OF SOLAR INFRARED SPECTRA. Tanaka, W.; Suemoto, Z.; Takada, M. (Tokyo Univ.). pp 82-85 of Large Balloon Symposium, 1971. Tokyo; Tokyo Univ. (1972). (In Japanese).

From large balloon symposium; Tokyo, Japan (13 Mar 1972).

Infrared spectra from the Sun in the range of 1.13 to 2.46 μ were observed. The observation is an extension of an observation carried out last year. A spectroscope was that used last year, which was a scanning monochrometer with a focal length of 554 mm and a resolving power of 30,000. The infrared detector was PbS with high-pass filters. A Sun follower introduced light vertically with two plane mirrors. A rough sensor and a precise sensor were employed. Solar batteries were used for the sensors. The rough sensor was mounted on the same frame as a main telescope to aim at the Sun. The precise sensor was set on the focal plane of the main telescope. Action of the Sun follower was watched by the light introduced to a Sun aspect meter by using surface reflection from an infrared filter. A balloon equipped with the apparatuses for the observation was released on September 15, 1971, and was in horizontal flight at the height of 28 km for about 14 hours. Operation of the direction control and Sun follower was normal. The observation of spectra, however, was incomplete, probably due to overheating. (JA)

1065 SOLAR ULTRAVIOLET MAGNESIUM DOUBLE LINE SPECTROSCOPY. Kono, T. (Mechanical Engineering Lab., Tokyo); Yajima, N.; Suemoto, Z. pp 86-92 of Large Balloon Symposium, 1971. Tokyo; Tokyo Univ. (1972). (In Japanese).

From large balloon symposium; Tokyo, Japan (13 Mar 1972).

The magnesium double line of the Sun around 2800Å was observed to investigate the chromosphere by using a balloon equipped with a Fabry–Pérot interference spectroscope. The spectroscope was a micro-monochrometer with a plane diffraction grafting of 600 line/mm, and a resolving power of 7Å. Light from the Sun was introduced by a Sun follower, a direction control by 3-step operation aimed at the Sun. A mirror of 50 mm dia. and 572 mm focal length was the main mirror of the optical system. Ultraviolet was observed through a convex lens. A diffraction filter was used to remove visible light. The balloon was released on September 16, 1971 and level flight was at a height of 34.4 km for 4 hours. Pointing was controlled within ±10″ of elevation and ±20″ of azimuth. Spectroscopic output was analyzed with proper correction. Absolute intensity of solar uv was obtained for the wavelengths of 2800Å and 2850Å. Results were compared with data taken by a French group. The intensity for the wavelength of 2800Å was estimated to be 2.4 watt/m²/100Å, which was a value within the range of most probable values 1 to 5 watt/m²/100Å. More precise observation with a larger balloon is in consideration. (JA)

1066 SOLAR GAMMA-RAY. Okudaira, K. (Rikkyo Univ., Tokyo). pp 166-167 of Large Balloon Symposium, 1971. Tokyo; Tokyo Univ. (1972). (In Japanese).

From large balloon symposium; Tokyo, Japan (13 Mar 1972).

Inelastic scattering processes for particles accelerated by

solar flares were calculated. The calculation was made on the inelastic scattering caused by ^{12}C and emitting gamma ray. The process considered is gamma-ray emission during the slowing down of the particles due to ionization loss. Protons, alpha particles, and carbon nuclei were taken into consideration as the accelerated particles. Distribution of magnetic rigidity was assumed to be exponential. Time variation of total number and yield of the emitted gamma-ray was investigated. The total number of gamma rays was proportional to total energy, regardless of mean energy, except the low-mean-energy range. The total energy of the particles accelerated on the solar surface, therefore, can be estimated from the time-integrated value of gamma-ray intensity. Relation of energy and mean rigidity is shown for protons, alpha particles, and ^{12}C. Applying this result to the observed result, the total energy of the nuclear component is estimated to be around 10^{29} erg. It was hard to determine attenuation time in time variation. Rate of the attenuation was in the order of carbon nuclei, alpha particles and protons; the smaller the mean energy, the faster the attenuation. Intensity of the gamma ray one second after emission was small by more than one order. It is, therefore, necessary for explaining the continuation of a gamma-ray burst for one min, to make a very low-density part of the atmosphere a gamma-ray production region, or to understand the phenomena as continuous particle emission from a confined region or a continuously accelerated region. (JA)

1067 PROJECT OF OBSERVATION OF INFRARED RAY IN ZODIACAL LIGHT. Hayakawa, S.; Ito, K.; Matsumoto, T.; Nishimura, T.; Ono, T. (Nagoya Univ., Japan). pp 184-189 of Large Balloon Symposium, 1971. Tokyo; Tokyo Univ. (1972). (In Japanese).

From large balloon symposium; Tokyo, Japan (13 Mar 1972).

An outline of an infrared telescope cooled by liquid nitrogen carried by a balloon is described. Purpose of the observation is also explained. The telescope was developed for the measurement of thermal radiation of dust in interplanetary space. Spatial distribution and temperature of the dust are obtained from the measurement. The telescope is shown schematically. The lowest part of the telescope is cooled by liquid nitrogen, and a thermal shield is applied to whole system. A detection element for the infrared is Ge : Au, and the signal to noise ratio is improved at low temperature. The main mirror of the optical system is a spherical mirror of 23 cm diameter and 0.5 of F number, and the auxiliary mirror is a modified Cassegrain type plane mirror. Incident infrared is focussed, converted to alternating signal, and absorbed by the Ge : Au element. The wavelength sensitivity relation (NEP) is shown. Value of the NEP is improved at 63°K by one order in comparison with the value at 77°K. A baffle system of 25 steps is installed in the cylinder of the telescope to limit direction. No effect from Earth radiation is expected when it is tilted up to 60° of zenith angle. Flight of a balloon is scheduled on July 10, 1972. (JA)

1068 ROCKET MEASUREMENTS OF PARTICLE FLUX DURING THE APRIL 1969 SOLAR COSMIC RAY EVENT. Tulyakov, V. V. Cosmic Res. (USSR) (Engl. Transl.); 10: No. 4, 570-571 (1972).

Translated from Kosm. Issled.; 10: No. 629(1972).

Experimental data obtained from a rocket probe during the large increase of solar particles of April 11-18, 1969 are presented. (WDM)

1069 WHERE ARE THE SATELLITES OF THE INNER PLANETS. Burns, J. A. (Inst. of Geophysics, Moscow). Nature (London) Phys. Sci.; 242: No. 115, 23-25(12 Mar 1973).

Among the more perplexing features of the solar system's morphology is the scarcity of satellites in the inner solar system; neither Mercury nor Venus seems to have satellites, the Earth has only one, and Mars is orbited merely by the tiny Phobos and Deimos. This situation is in sharp contrast to the case of the outer planets which have extensive satellite systems. Often the distinction between the inner and outer satellite systems is taken as proof of a different origin for the two groups of planets or, at the very least, as showing that those physical processes (for example, radiation pressure or Poynting–Robertson drag) which were instrumental in the formation of the outer satellite families were not important in the inner solar system. It is shown, however, that the premise on which these statements is based may be false in that the present absence of satellites in the inner solar system may be a recent phenomenon and not a condition of origin. Simple calculations indicate that both Mercury and Venus, and perhaps Pluto, could have had substantial satellites earlier in the solar system's life, these satellites having been subsequently eliminated by tidal friction. Other results show that small satellites of Mars and the Earth could have eroded away during the lifetime of the solar system. (auth)

Galaxies

Refer also to abstract 1048.

1070 MULTICOLOR PHOTOMETRY OF FIVE SBc GALAXIES: NGC 925, NGC 1073, NGC 3359, NGC 4088, AND NGC 7741. Pronik, I. I. Izv. Krym. Astrofiz. Observ.; 45: 162-171(1972). (In Russian).

Multicolor photometry of bars and spiral arm patches for five SBc galaxies was carried out. The photographs were obtained on 2.6 mα telescope with an image-converter and seven color filters. The spectral energy distribution of bars was found to be similar to that of the central parts of ordinary type S and I galaxies. It is possible that there is an ultraviolet excess in some of them. All bars are redder than the spiral arm patches. The bars of the galaxies NGC 925, NGC 1073, and NGC 7741 have H_α emission of the same order of magnitude as the central parts of ordinary galaxies. But the bars of NGC 3359 and NGC 4088 show higher values of the H_α emission. (auth)

1071 SPACE OBSERVATIONS OF THE NIGHT-SKY BRIGHTNESS WITH KOSMOS-51 AND KOSMOS-213. I. Method and Calibration of the Measurements. Dimov, N. A.; Severnyi, A. B. Izv. Krym. Astrofiz. Observ.; 45: 53-66(1972). (In Russian).

The wide-angle (18°) photometers for simultaneous records of the ultraviolet (λ = 2700 to 2800 Å) and the visual (λ = 4800 to 5200 Å) regions of the night sky radiation are described. The records of the dark currents and of the brightness of the luminofor (activated by ^{14}C) are also provided. The descriptions of photomultipliers and of electronic scheme are given. The measured laboratory response-curves of both ultraviolet and visual photometers are presented. The ratio b_U/b_V—of maximal responses for ulv and visual channels is determined for the photometer installed on Kosmos-51. The brightness of the luminofor is determined for both experiments (in the number of stars $m_V = 10^m$ per square degree). The limiting sensitivity of the photoelectric photometry was about ±20 to 30 stars $m_V = 10^m$ per square degree. (auth)

1072 SPACE OBSERVATIONS OF THE NIGHT-SKY BRIGHTNESS WITH KOSMOS-51 AND KOSMOS-213. II. The Results and Discussion. Dimov, N. A.; Zvereva, A. M.; Severnyi, A. B. Izv. Krym. Astrofiz. Observ.; 45: 67-89(1972). (In Russian).

With the aid of photometers installed on board Kosmos-51 and Kosmos-213 the brightness of nightsky was measured in the visual and ultraviolet regions. (WDM)

Cosmology

1073 ANISOTROPIC UNIVERSE WITH TORSION. Kopczynski, W. (Inst. of Theoretical Physics, Warsaw). Phys. Lett.; 43A: No. 1, 63-64(12 Feb 1973).

The problem of a spatially flat and homogeneous gravitational field produced by spinning matter is considered within the framework of the Einstein–Carton theory. If the effect of torsion is greater than that of shear, solutions of the field equations have no cosmological singularity. (auth)

1074 GRAVITATIONAL ABERRATIONS IN STELLAR IMAGES. Cook, M. W. (Univ. of New England, Armidale, Australia). Aust. J. Phys.; 25: No. 6, 749-758(Dec 1972).

On the basis of a cosmological model which is fundamentally of the Friedmann expanding type with a spherically symmetric inhomogeneity superimposed, a study is made of three gravitational aberrations of purely relativistic origin observed in the images of stellar objects: (1) the "gravitational lens" effect, (2) a dispersion effect whereby a point source would produce a diffuse image, and (3) an apparent systematic motion of all light sources towards (or away from) the inhomogeneity. Admissable inhomogeneities in the model must satisfy $PU \leq 2 \times 10^4$ Mpc, where P is the ratio of the average density of matter within the inhomogeneity to the average density of the Universe and U is its diameter in megaparsecs. The assumption is also made that the paths of light rays are described by the null-geodesic equations of the space–time under consideration. (auth)

1075 DERIVATION OF EQUATIONS OF A SPINOR IN COSMOLOGICAL SPACE. Kurdgelaidze, D. F.; Plyusnin, L. N. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 10, 20-25(1972). (In Russian).

The equation for a spinor field in curved space was constructed by the method of insertion. The conditions for equivalence of the equations of a spinor field in the original four-dimensional space and in a plane six-dimensional space of insertion were considered. (tr-auth)

1076 PRINCIPLE OF RECIPROCITY. Khan, I. (International Physics, Trieste, Italy). Int. J. Theor. Phys.; 6: No. 5, 383-397(Dec 1972).

It is shown that the validity of the principle of reciprocity for arbitrary motion implies that the rate of a moving clock departs from the (instantaneous) special relativistic value by a term $-\ddot{x}x/2c^2$ where x is the distance of the clock. Through this effect the cosmological redshift can be understood as arising from the outward acceleration of radiation atoms in galactic gravitational fields. In this way the relation $(GM/2cL^2) \sim (1/H)$ between Newton's constant of gravitation G, the mass M and linear dimension L of a typical galaxy and Hubble's constant H is derived. This relation is verified by present-day observations. Implications of these considerations for quasars are briefly discussed. As a possible test of this theory it is suggested that the spectra of galaxies be searched for the presence of blue-shifted lines which are expected to be fainter by three to four magnitudes in comparison with the red-shifted lines. (auth)

Planetary Phenomena

Refer also to abstract 1069.

1077 CONTENT OF NATURAL RADIOACTIVE ELEMENTS IN VENUSIAN ROCK ACCORDING TO DATA OF THE AUTOMATIC STATION VENERA 8. Vinogradov, A. P.; Surkov, Yu. A.; Kirnozov, F. F.; Glazov, V. N. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Geokhimiya; No. 1, 3-10(Jan 1973). (In Russian).

The contents of natural radioactive elements in Venusian superficial rock have for the first time been determined with the aid of a scintillation γ-spectrometer set on the interplanetary automatic station Venera-8. The revealed uranium, thorium, and potassium contents, which are $2.2 \cdot 10^{-4}$%; $6.5 \cdot 10^{-4}$%, and 4% respectively, as well as the presence of a dense and hot atmosphere around the Venus consisting by 97% of CO_2 and the low density of its superficial rock (1.4 g/cm³) allowed the authors to conclude that processes of deep metamorphism are taking place on the surface of the Venus. The station Venera-8 has also detected a metamorphic rock being relatively rich in natural radioactive elements in comparison with basalts of the Earth. (auth)

1078 OXYGEN AND BULK ELEMENT ABUNDANCES IN LUNA 20 FINES. Janghorbani, M.; Gillum, D. E.; Ehmann, W. D. (Univ. of Kentucky, Lexington). Geochim. Cosmochim. Acta; 37: No. 4, 905-908(Apr 1973).

Abundances of O, Si, Al, and Mn have been determined in Luna 20 fines sample 22,001.9 by instrumental neutron activation analysis. The abundances of O, Si, and Al are among the highest observed in lunar samples and reflect a highlands origin for much of this regolith sample. The Luna 20 abundances reported here most closely resemble those determined in four samples of two Apollo 16 fines, rock 14,310, and a clast from breccia 15,459. The Luna 20 O/Si ratio of 1.96 ± 0.05 is similar to that in most other lunar samples, but the Al/Si ratio of 0.532 ± 0.024 is exceeded only by data on the Apollo 16 fines. This Al/Si ratio is in agreement with the value of 0.55 ± 0.06 determined by the remote x-ray fluorescence experiment for the highlands between Mare Crisium and Mare Smythii which lie near the Luna 20 site (Adler et al., (1972)). (auth)

1079 U–Th–Pb MEASUREMENTS OF LUNA 20 SOIL. Tatsumoto, M. (Geological Survey, Denver). Geochim. Cosmochim. Acta; 37: No. 4, 1070-1086(Apr 1973).

The concentrations of uranium, thorium, and lead and the lead isotopic composition of Luna 20 soil were determined. The data indicate that the Luna 20 soil is mainly a mixture of highland anorthosites and low-K basalt, but little KREEP basalt. The U–Th–Pb systematics are discussed in comparison with other lunar soils, especially with Apollo 16 soils which were collected from a "typical" highland region. The data fit well in the Apollo 16 soil array on U–Pb evolution diagram, and they exhibit excess lead relative to uranium. This relationship appears to be a characteristic of highland localities. Considering the previous observations of lunar samples, it is inferred that lead enrichment in the soil relative to uranium occurred between 3.2 and 3.9 b.y. ago and that the soil was disturbed by "third events" about 2.0 b.y. ago. A lunar evolution model is discussed. (auth)

1080 LUNA 20 SOIL. Abundance of 17 Trace Elements. Morgan, J. W.; Kraehenbuehl, U.; Ganapathy, R.; Anders, E. (Univ. of Chicago). Geochim. Cosmochim. Acta; 37: No. 4, 953-961(Apr 1973).

The following elements were determined in two Luna 20 samples by radiochemical neutron activation analysis: Ag, Au, Bi, Br, Cd, Cs, Ge, In, Ir, Rb, Re, Sb, Se, Te, Tl, U, and Zn. Luna 20 soil is remarkably similar to Apollo 16 soil, in its content of these 17 mainly volatile or siderophile elements. Like other highland soils, it seems to contain an ancient meteoritic component of fractionated, volatile-poor composition. The bulk soil has a high Tl/Cs ratio (9.4×10^{-3}), similar to that in Apollo 16 soils (5.4×10^{-3}), but higher than that in samples from other sites (1.1×10^{-2}). It is severely contaminated with Ag, Cd, Re, and Sb, judging from a comparison with a 1.7 mg soil breccia sample from the coarse fraction of the soil. (auth)

1081 RADIATION DAMAGE IN LUNA 20 SOIL. Phakey, P. P.; Price, P. B. (Univ. of California, Berkeley). Geochim. Cosmochim. Acta; 37: No. 4, 975-977(Apr 1973).

Micron-sized soil grains from the Luna 20 mission are the most lightly irradiated of those examined, in contrast to micron-sized grains from the Luna 16 soil, which are the most heavily irradiated. Radiation damage in micron-sized grains is inversely correlated with albedo of the soil. The absence of angular, amorphous grains in Luna 20 supports the previous contention that such grains in Luna 16 were produced by intense radiation damage. (auth)

1082 HALOGENS IN LUNA 16 AND LUNA 20 SOILS. Reed, G. W.; Jovanovic, S. (Argonne National Lab., IL). Geochim. Cosmochim. Acta; 37: No. 4, 1007-1009(Apr 1973).

The halogens Cl, Br and I, as well as U and Li have been determined in ~25 mg of the 125 μm Luna 16 and 20 soils. Cl and P_2O_5 do not appear to exhibit the same correlation in soils from the Luna 20 and possibly the Luna 16 sites as they do in samples from the Apollo 11 to 15 sites. Nevertheless, the coherence between labile Cl and other KREEP-related elements is maintained. (auth)

1083 OXYGEN AND SILICON ISOTOPE RATIOS OF THE LUNA 20 SOIL. Taylor, H. P. Jr.; Epstein, S. (California Inst. of Tech., Pasadena). Geochim. Cosmochim. Acta; 37: No. 4, 1107-1109(Apr 1973).

The $\delta^{18}O$ and $\delta^{30}Si$ analyses of the Luna 20 soil sample are +6.18(‰) and +0.22(‰), respectively, relative to the SMOW and Rose Quartz standards. However, an anomalous $\delta^{18}O$ value of +8.13(‰) was obtained on one aliquot of the Luna 20 sample. Possible reasons for this apparently erroneous result are discussed. (auth)

1084 CHEMICAL COMPOSITION OF LUNA 20 SOIL AND ROCK FRAGMENTS. Jerome, D. Y. (Univ., Paris); Philippot, J. C. Geochim. Cosmochim. Acta; 37: No. 4, 909-914(Apr 1973).

Abundances of the following 22 elements, including 9 rare earth elements (REE), have been determined by "monostandard" instrumental neutron activation analysis of samples from the Luna 20 soil and in 6 rock fragments, including a crystalline rock of highland origin, a breccia of similar composition, a glass and a feldspar grain: Na, Al, Ca, Sc, Ti, Cr, Mn, Fe, Co, Mo, La, Ce, Nd, Sm, Eu, Tb, Tm, Yb, Lu, Hf, W, Th. The soil appears to have been contaminated with W and Mo. The REE content of the soil is very low, being close to 2.3 times below the level in the Luna 16 soil. Sampling errors, for most elements, are negligible in the case of analyses performed on one or several tens of mg of soil, but they become significant on crystalline rock fragments in the 1 to 2 mg range. (auth)

1085 FORMATION OF SPECTRAL LINES IN PLANETARY ATMOSPHERES. 5. Collision Narrowed Profiles of Quadrupole Lines in Hydrogen Atmospheres. Hunt, G. E.; Margolis, J. S. (Jet Propulsion Lab., Pasadena, CA). J. Quant. Spectrosc. Radiative Transfer; 13: No. 5, 417-426(May 1973).

The interpretation of a hydrogen quadrupole spectrum is complicated by the collision narrowing phenomenon exhibited by these lines. The profile must be accurately computed for use within any interpretative technique since the spectroscopic features of line profile and center to limb variation of the equivalent width are sensitive to the quadrupole line shape. The Dicke profile, which assumes that the quadrupole line shape is Lorentzian with a half-width that varies inversely as the pressure has been suggested as a simple alternative to the Galatry profile. Comparisons are presented of the line profile, equivalent width and center-to-limb variation of the equivalent width of quadrupole lines for a characteristic scattering and nonscattering hydrogen atmosphere, where the line profile has been computed by the Dicke and Galatry shapes. Computations show that the results produced by the Dicke profile may be very different from the features predicted by the Galatry profile, which has been shown to give results in good agreement with experiment. It is therefore concluded that it is invalid to use the Dicke approximation for computing collision-narrowed profiles of hydrogen quadrupole lines at visible and near infrared spectroscopic wavelengths in any hydrogen atmosphere. (auth)

1086 DOES SPECTROSCOPIC EVIDENCE REQUIRE TWO SCATTERING LAYERS IN THE VENUS ATMOSPHERE. Regas, J. L.; Boese, R. W.; Giver, L. P.; Miller, J. H. (Chico State Univ., CA). J. Quant. Spectrosc. Radiative Transfer; 13: No. 5, 461-463(May 1973).

The phase variation of lines in the 7820 and 7883 Å CO_2 bands was interpreted by Hunt (J. Quant. Spectrosc. Radiat. Transfer;

12:387 and 12:405 (1972)) using an inhomogeneous, anisotropic scattering model of the Venus atmosphere. It was concluded that the Venus atmosphere contains two scattering layers. It is shown in the present paper that the observed phase variation may be due to the strong backward lobe in the Venus cloud phase function and that two cloud layers are not necessarily required. (auth)

1087 CHEMICAL COMPOSITION OF LUNA 20 ROCKS AND SOIL AND APOLLO 16 SOILS. Laul, J. C.; Schmitt, R. A. (Oregon State Univ., Corvallis). Geochim. Cosmochim. Acta; 37: No. 4, 927-942(Apr 1973).

The abundances of the following 24 major, minor, and trace elements have been measured by instrumental neutron activation analysis (INAA) in Luna 20 metaigneous rocks 22006,1 and 22007,1, breccia 22004 and soil 22001,9 and in Apollo soils 62281, 66041, and 66081: Ti, Al, Fe, Mg, Ca, Na, K, Mn, Cr, Sc, V, Co, La, Ce, Sm, Eu, Tb, Dy, Yb, Lu, Hf, Ta, Th, U. An additional 12 trace meteoritic and nonmeteoritic elements (Ni, Co, Au, Se, Sb, Ag, In, Zn, Cd, Rb, Cs, Tl) have also been determined in 22001 and 62281 soils by radiochemical neutron activation analysis (RNAA). The bulk compositions of L 20 and Ap 16 rocks and soils show close similarity between the two highland sites. There are appreciable differences in bulk compositions between the L 20 highland and the L 16 mare site (120 km apart), suggesting little intermixing of rocks and soils from either site. Luna 20 rocks 22006 and 22007 are nearly identical in chemical composition to Ap 16 metaigneous rocks 61156 and 66095. Luna 20 rocks are feldspathic and are similar to low K-type Fra Mauro basalts. Such rocks and anorthositic gabbros appear to be the major components in highland soils. Luna 20 soil can be distinguished from Ap 16 soils by lower abundances of Al_2O_3, CaO and large ion lithophilic elements. Luna 20 breccia 22004 probably is compacted soil. All L 20 samples show negative Eu anomalies with Sm/Eu ratios of 5.8, 7.2, 3.9, and 3.3 for rocks 22006, 22007, breccia 22004, and soil 22001, respectively. Norite-KREEP is insignificant, ≤1%, at the L 20 highland site. The derivation of the L 20 soil may be explained by ≈33% of L 20 metaigneous rocks and ≈65% anorthositic gabbroic breccia rocks like 15418 (with a positive Eu anomaly) and ≈2% meteoritic contributions. Interelement correlations observed previously for maria are also found in highland samples. (auth)

1088 INERT GASES IN A TERRA SAMPLE. Measurements in Six Grain-Size Fractions and Two Single Particles from Luna 20. Heymann, D.; Lakatos, S.; Walton, J. R. (Rice Univ., Houston, TX). Geochim. Cosmochim. Acta; 37: No. 4, 875-885(Apr 1973).

The inert gases have been measured in six size fractions covering the range below 500 μm, in a single feldspathic fragment weighing 523 μg, and in an agglutinate particle weighing 465 μg. The two size fractions between 125 and 350 μm as well as 250 and 500 μm were separated into magnetic and nonmagnetic portions, which were measured separately. Like the Apollo and Luna 16 fines, the terra fines represented by Luna 20 are very rich in trapped solar-wind gases, but they contain relatively less ^{4}He and ^{20}Ne, which is revealed by their average $^4He/^{20}Ne$ ratio of 35 and $^{20}Ne/^{36}Ar$ ratio of 2.9. Obviously the terra materials are less retentive for solar-wind He and Ne than typical mare fines such as 10084. Whether this is due to the relatively small TiO_2 or the relatively large plagioclase content of the former is not resolved. $(^{36}Ar/^{84}Kr)_{trapped}$ and $(^{36}Ar/^{132}Xe)_{trapped}$ ratios are relatively large; the average values are 2800 and 14400, respectively. The apparent ^{21}Ne radiation ages of all the size fractions are in the range 209 to 286×10^6 yr; the average is 260×10^6 yr. This is in the range of values known for the Apollo and Luna 16 fines. The feldspathic fragment has a much greater apparent ^{21}Ne age of 780×10^6 yr. The $^{40}Ar-^{36}Ar$ systematic reveals the presence of two ^{40}Ar components, because $^{40}Ar = (1.41 \pm 0.076)^{36}Ar + (0.490 \pm 0.130) \times 10^{-4}$ (cm^3STP/g). The $^{40}Ar/^{36}Ar$ slope of 1.41 is not inconsistent with an origin of the sample from a relatively old terra region. (auth)

PHYSICS (ATMOSPHERIC)

Auroral and Ionospheric Phenomena

1089 BRIEF REVIEW OF SCINTILLATION STUDIES. Hartmann, G. K. (Max-Planck-Institut fuer Aeronomie, Lindau, Ger.). *J. Sci. Ind. Res.; 30: No. 8, 414-420(Aug 1971).*

The emphasis is mainly on ionospheric scintillations and their geophysical aspects. Experimental and theoretical aspects of trophospheric and interplanetary scintillations, as well as aspects of recent communication theory are also briefly considered. (WDM)

Magnetospheric Phenomena

Refer also to abstracts 447 and 1055.

1090 *LOSSES OF ULTRARELATIVISTIC ELECTRONS IN THE* GEOMAGNETIC TRAP. Il'in, V. D. Cosmic Res. (USSR) (Engl. Transl.); 10: No. 4, 566-567(1972).

Translated from Kosm. Issled.; 10: No, 626-627(1972).

It is shown that losses of ultrarelativistic electrons on account of nonadiabatic effects in a static geomagnetic field may dominate in that region of the magnetosphere which is far removed from the region where excess radiation is observed. (WDM)

1091 DYNAMICS OF THE OUTER RADIATION BELT DURING THE INTERNATIONAL QUIET SUN YEAR. Vernov, S. N.; Kuznetsov, S. N.; Logachev, Yu. I.; Lopatina, G. B.; Stolpovskii, V. G. Cosmic Res. (USSR) (Engl. Transl.); 10: No. 4, 489-497 *(1972).*

Translated from Kosm. Issled.; 10: No, 545-554(1972).

The investigations of the outer radiation belt and the zone of unstable radiation carried out on board the "Élektron" satellites during the period of minimum solar activity (1964–1965) are summarized. Phenomena occurring during magnetically quiet and disturbed periods are considered. The variations of the outer belt during magnetic storms indicate an intensification of the electric field in the magnetosphere and a surge of plasma from the tail to the core of the magnetosphere. Also investigated are the transverse diffusion of the electrons in the outer belt and the height dependence of the electron flux on different L shells. (auth)

PHYSICS (ATOMIC AND MOLECULAR)

Beams and Their Reactions

Refer also to abstract 569.

1092 (CONF-720669–, pp 510-523) QUASI-MOLECULAR IONIZATION OF ATOMS BY FAST HEAVY IONS. Kessel, Q. *(Univ. of Connecticut, Storrs). 1972.*

In proceedings of heavy-ion summer study.

1093 *(CONF-720669–, pp 524-550)* CHARGE STATES AND CHARGE-CHANGING CROSS SECTIONS OF FAST HEAVY IONS. Betz, H. D. (Massachusetts Inst. of Tech., Cambridge). 1972.

In proceedings of heavy-ion summer study.

1094 *(CONF-720669–, pp 564-585)* POSSIBILITIES OF USING HEAVY-ION BEAM FOIL SPECTROSCOPY TO OBTAIN ASTROPHYSICAL INFORMATION. Bashkin, S. (Univ. of Arizona, Tucson). 1972.

In proceedings of heavy-ion summer study.

1095 *(CONF-720669–, pp 586-602) INVESTIGATIONS OF* POTENTIALS AND STOPPING-POWER FUNCTIONS USING HEAVY-ION CHANNELING IN SINGLE CRYSTALS. Appleton, B. R. *(Oak Ridge National Lab., TN).* 1972.

In proceedings of heavy-ion summer study.

1096 *(CONF-720669–, pp 617-730) USE OF ACCELERATORS TO STUDY RADIATION DAMAGE.* Koehler, J. S. (Univ. of Illinois, Urbana). 1972.

In proceedings of heavy-ion summer study.

1097 CLASSICAL CALCULATION OF PARAMETERS OF ELASTIC SCATTERING OF ELECTRONS BY A XENON ATOM. Igropulo, V. S. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 10, 69-73(1972). (In Russian).

Calculations of the quasi-classical phase (with an accuracy of the magnitude of $\hbar^2$) were conducted, of the differential and total cross sections of elastic scattering of electrons by a Xe atom. An approximation of the statistical field was employed, with and without the exchange allowance. (tr-auth)

Atomic and Molecular Properties

1098 EFFECT OF FIELD THEORETICAL CORRECTIONS ON X-RAY SPECTRA. Krishnan, T. V. (Bhabha Atomic Research Centre, Trombay, India); Nigam, A. N. Proc. Indian Acad. Sci., Sect. A; 77: No. 1, 26-41(Jan 1973).

The wavelengths of $K_{\alpha 1}$, $K_{\alpha 2}$, $K_{\beta 1}$, $K_{\beta 3}$, $K_{\beta 2}I$ and $K_{\beta 2}II$ lines of heavy elements of atomic number 70 to 92 and the associated levels, K, L_{II}, L_{III}, M_{II}, M_{III}, N_{II} and N_{III} have been calculated using a modified form of the relativistic energy formula of Sommerfeld, incorporating in it both the total and internal screening constants in a closed form. All the field theoretical corrections in the second and the fourth order as well as the finite nuclear size correction have been included. The relative intensities $K_{\alpha 2}/K_{\alpha 1}$, $K_{\beta 3}/K_{\beta 1}$ and $K_{\beta 2}II/K_{\beta 2}I$ have been calculated with relativistic wave functions. In addition to the retardation and screening, field theoretical corrections have also been used. A logical extension of the one-electron model with application of the field theoretical corrections improves the calculated results of not only the energy levels but also the relative intensities of x-ray lines. (auth)

1099 *COSTER–KRONIG AND FLUORESCENCE YIELDS FOR* THE L_2 AND L_3 SUBSHELLS IN THE HIGH-Z REGION. McGeorge, J. C.; Nix, D. W.; Fink, R. W. (Georgia Inst. of Tech., Atlanta). J. Phys., B (London); No. 3, 573-583(Mar 1973).

High resolution intrinsic Ge(HP) and Si(Li) x ray detectors have been used in coincidence to determine L_2 and L_3 subshell fluorescence and Coster–Kronig yields at Z = 86, 88, and 94. The results are: $\nu_2 = 0.498 \pm 0.028$, $\omega_2 = 0.459 \pm 0.025$, $f_{23} = 0.105 \pm 0.011$, $\omega_3 = 0.384 \pm 0.020$ at Z = 86; $\nu_2 = 0.516 \pm 0.036$, $\omega_2 = 0.493 \pm 0.030$, $f_{23} = 0.053 \pm 0.026$, $\omega_3 = 0.408 \pm 0.027$ at Z = 88; and $\nu_2 = 0.627 \pm 0.036$, $\omega_2 = 0.513 \pm 0.022$, $f_{23} = 0.226 \pm 0.016$, $\omega_3 = 0.509 \pm 0.029$ at Z = 94. Together with previously published data these results provide evidence that in the L_2–L_3 Coster–Kronig process, ejection of an M_5-subshell electron is energetically possible at Z = 92 and that M_4- and M_5-subshell electron ejection are both possible at Z = 94. These conclusions are shown to be consistent with the L x ray line width measurements of Merrill and DuMond (Ann. Phys. N. Y.; 14: 166-228 (1961)) and with the formula put forward by Coster and Kronig (Physica; 2: 13-24 (1935)) for the ejected electron energy. Recent theoretical predictions of the L-subshell yields compare favorably with experiment, except when Coster–Kronig transitions close to an energy threshold are involved. (auth)

1100 LONG-RANGE HYPERFINE SHIFT IN HeH. Fortune, P. J.; Certain, P. R. *(Univ. of Wisconsin, Madison). J. Phys.,* B (London); 6: No. 3, L39-L41(Mar 1973).

The leading term in the asymptotic expansion of the hyperfine shift in HeH has been computed with the result $\Delta a(R)/a(\infty) = (11.361 + 1.901)R^{-6}$. (auth)

1101 EVALUATION OF THE EVEN WAVE FUNCTIONS OF THE HYDROGEN ATOM IN THE PATH-INTEGRAL FORMALISM. Goovaerts, M. J.; Broeckx, F.; Van Camp, P. Physica; 64: No. 1, *47-62(15 Feb 1973).*

A straightforward analytical calculation of the s-like wave functions of the hydrogen atom is performed, entirely within Feynman's path-integral formalism. For this purpose the integral transform: $W = \int d^3r_\beta K(r_\beta, r_0)$, is calculated by means of an exact summation of a "modified" perturbation expansion. $K(r_\beta, r_0)$ is the density matrix of the hydrogen atom, written as a path integral. Previously the wave functions had been obtained almost accidentally and at first sight one did not succeed in proving the uniqueness of the wave functions thus obtained. A generalization of the method explained is given providing us with the s-like wave functions for the case of the hydrogen atom. (auth)

1102 THEORY OF QUASIBOUND STATES. Comparison with Experiment for HeH^+ ISOTOPES. Peek, J. M. (Sandia Labs., Albuquerque, NM). Physica; 64: No. 1, 93-113(15 Feb *1973).*

The energy and widths for all quasibound states of the $^4HeH^+$, $^3HeH^+$, $^4HeD^+$, and $^3HeD^+$ isotopes are calculated by methods that utilize their near-discrete state character. A method for the enumeration of these states is also proposed. Comparisons with the standard phase-shift method indicate these proposed techniques are useful and offer certain advantages. The energies of the quasibound states show at least semiquantitative agreement with sharp features observed in the energy of the H^+ or D^+ fragments which are produced both by unimolecular and single-collision dissociation mechanisms. Requirements on the widths (lifetimes) of the states used in this comparison are also satisfied. The agreement is best for the $^4HeH^+$ and $^3HeH^+$ cases. Tests of two potentials for the HeH^+ system indicate that part of the discrepancy between theory and experiment is due to errors in the best available potential function. Hence, quasibound states are presumed to be responsible for the sharp features observed in the H^+ and D^+ dissociation energy. This conclusion is in agreement with the mechanisms proposed by the experimental groups. (auth)

1103 ISOTOPE SHIFT IN THE INFRARED SPECTRUM OF Ne I. Keller, J. C.; Lesprit, J. F. (CNRS, Orsay, France). Physica; 64: No. 1, 202-208(15 Feb 1973).

The isotopic shift $^{20}Ne-^{22}Ne$ was measured for 19 lines in the range $3-8\,\mu$. Three different laser-spectroscopy methods were used. In the best case, an accuracy of 0.02 mK was obtained. (auth)

1104 SPATIAL DEPENDENCE OF THE EXCHANGE COUPLING IN THE HEAVY RARE EARTHS. Darby, M. I.; Richardson, N. (Univ. of Salford, Eng.). J. Phys., F (London); 3: No. 3, *L35-L37(Mar 1973).*

Some results of Liu et al (Phys. Rev.; B4: 1100 (1971)) have been inverted to give the spatial dependence of the exchange interaction along the c axis in the rare earth metals Gd, Tb, Dy and Er. It is found that the interaction is significant out to at least six lattice spacings. (auth)

1105 IONIZATION POTENTIAL AND THE $4s4p^6nl$ LEVELS *OF* ^{86}Kr 1. *Chaghtai, M.S.Z.; Hassan, V. (Aligarh Muslim Univ.,* India). J. Phys., B (London); 6: No. 3, 433-435(Mar 1973).

The ionization potential of ^{86}Kr 1 is 112,925 ± 10 cm^{-1}. From possible series perturbations, the two 5s, the four 5p and four 4f levels belonging to the parentage $4s\,4p^6$ are calculated. (auth)

1106 *MEAN ENERGY LOSS PER ION PAIR AND STOPPING* POWER OF HELIUM GAS FOR ELECTRONS. Jhanwar, B. L.; Khare, S. P. (Univ. of Meerut, India). J. Phys., B (London); 6: No. 3, 462-466(Mar 1973).

The expressions proposed by Khare (J. Phys. B. Atom. Molec. *Phys.; 3: 971-5 (1970)) for the energy loss cross sections and the* first Born cross sections for the excitations of helium atom due to electron impact are utilized to calculate the mean energy loss per ion pair and the stopping power of helium gas for 50 eV to 10 eV electrons. The results are in good agreement with other theoretical values and experimental data. (auth)

1107 VARIATIONAL APPROXIMATIONS TO THE $2p\sigma_u$ *AND* $2p\pi_u$ *WAVEFUNCTIONS OF THE HYDROGEN MOLECULE*

ION. Arista, N. R.; Ponce, V. H. (Comision Nacional de Energia Atomica, San Carlos de Bariloche, Argentina). J. Phys., B (London); 6: No. 3, 511-513(Mar 1973).

It is shown that trial wavefunctions for the $2p\sigma_u$ and $2p\pi_u$ states of H_2^+ with three variational parameters, separable in elliptic coordinates give excellent results for the energy eigenvalues as functions of the internuclear coordinate. It is also seen that there are two minima for the energy as a function of the parameters. Earlier results for the same trial function used for the $2p\sigma_u$ state are in error because the optimization has not always been carried out for the absolute minimum. (auth)

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

1108 NEW PRECISION MEASUREMENT OF THE MUONIUM HYPERFINE INTERVAL IN ARGON. Kobrak, H. G. E. (Univ. of California, San Diego, La Jolla); Swanson, R. A.; Favart, D.; Kells, W.; Magnon, A.; McIntyre, P. M.; Roehrig, J.; Stowell, D. Y.; Telegdi, V. L.; Eckhause, M. Phys. Lett.; 43B: No. 6, 526-528 (19 Mar 1973).

The muonium hyperfine interval $\Delta\nu$ in argon was measured at 1802 torr, and $\Delta\nu$ = 4463.2653(24) MHz was found. The extrapolation to zero density yields perfect agreement with $\Delta\nu$ measured with comparable accuracy in krypton. The argon and krypton results are therefore combined to give a new world average of $\Delta\nu$ = 4463.3040(18) MHz. (auth)

Collision Phenomena

Refer also to abstracts 1380 and 1381.

1109 (CONF-720669-, pp 551-563) AUTOIONIZATION OF ATOMS PRODUCED IN HEAVY-ION COLLISIONS. Sellin, I. A. (Oak Ridge National Lab., TN). 1972.

In proceedings of heavy-ion summer study.

1110 (NP-19715) EXPERIMENTAL INVESTIGATION OF A ROLE OF LASER RADIATION STATISTIC IN A MULTIPHOTON IONIZATION PROCESS OF AN ATOM. Alimov, D. K.; Arslanbekov, T. U.; Beklin, M. S.; Delone, N. B.; Monastyrskii, O. B. (Akademiya Nauk SSSR, Moscow. Fizicheskii Institut). 1973. 12p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The 11-photon ionization of a xenon atom by radiation of two Nd-glass lasers was observed. The results showed that under the same field strength and multimode laser radiation effects the number of ions formed is ~10^3 times greater than in the case of a single-mode laser. (JFP)

1111 FRAGMENTATION OF NEGATIVE IONS FORMED IN COLLISIONS OF ALKALI ATOMS AND HALOGEN MOLECULES. Baede, A.P.M.; Auerbach, D. J.; Los, J. (FOM-Instituut voor Atoom- en Molecuulfysica, Amsterdam). Physica; 64: No. 1, 134-148(15 Feb 1973).

Total cross sections have been measured for the production of negative halogen ions in collisions between alkali atoms and homonuclear halogen molecules at relative energies from threshold up to about 20 eV. By means of a mass spectrometer the cross sections for negative parent-ion and fragment-ion production could be measured separately. These measurements confirm the previously measured adiabatic electron affinities of the homonuclear halogen molecules. The fragment- and parent-ion cross sections are about equally large. It was found that the general behavior of the fragment-ion cross sections is characteristically dependent on the alkali collision partner: the potassium cross sections peak sharply at energies just above threshold; the sodium cross sections, however, have a smooth maximum at higher energies. This could be explained qualitatively by a simple model. (auth)

1112 ELECTRON CAPTURE AND EXCITATION IN He^{2+}–He COLLISIONS. Mukherjee, S. C.; Roy, K.; Sil, N. C. (Indian Association for the Cultivation of Science, Calcutta). J. Phys., B (London); 6: No. 3, 467-476(Mar 1973).

The cross sections of single and double electron capture for an alpha particle passing through a helium atom have been calculated for incident ion energies ranging from 50 to 1500 keV, using the impact parameter method. The momentum transfer and exchange of electrons have been taken into account. The 2s and 2p excitations of ionized helium in both direct and captured states have been calculated by a perturbation method. The results obtained are compared with the available experimental results and other theoretical findings. The present calculated results for double capture cross sections are found to be in fairly good agreement with the experimental findings up to energy of about 750 keV. The inclusion of 2s and 2p excited states modifies the single capture cross section in better agreement with the experimental findings in the incident energy region E > 150 keV. The perturbation method applied seems not suitable below 150 keV. The calculated cross sections for excitations of the resultant target helium ion and for single capture into the corresponding excited states are found to be nearly equal in the energy region E < 1000 keV. (auth)

1113 IONIZATION PROCESSES IN SLOW COLLISIONS OF HEAVY PARTICLES. 2. Symmetrical Systems of the Rare Gases He, Ne, Ar, Kr. Gerber, G.; Morgenstern, R.; Niehaus, A. (Univ., Freiburg i. B.). J. Phys., B (London); 6: No. 3, 493-510(Mar 1973).

Ionization processes occurring in collisions of He^+ and He with He, Ne and Ne^+ with Ne, Ar and Ar^+ with Ar, and Kr and Kr^+ with Kr in a kinetic laboratory energy range from threshold up to 10 keV are investigated by electron spectroscopy using an apparatus described in a previous publication (Gerber et al. J. Phys. B. Atom. Molec. Phys.; 5: 1396-1411(1972)). Electron spectra obtained at different collision energies, and, in some cases, at different detection angles, are reported for all collision systems. Further an excitation function for the Ar (...$3s3p^6 4s$) auto-ionizing state is shown and analyzed in terms of the Landau-Zener two-state model. The electron spectra of the systems He-He and Ar-Ar for the first time give clear evidence of the occurrence of autoionization of the molecular system formed during the collision. They also give evidence of the formation of the negative ions $He^{*-}(1s2s^2)$, $Ne^{*-}(2p^5 3s^2)^2P_{\frac{1}{2},\frac{3}{2}}$, and $Ar^{*-}(3p^5 4s^2)^2P_{\frac{1}{2},\frac{3}{2}}$ in He-He, Ne-Ne and Ar-Ar collisions, respectively. In the case of the collisions of He^+ and He with He an analysis of the results on the basis of the one electron MO correlation diagram is carried out. An explanation of the observed fact that autoionizing states are excited in Ar-Ar and Kr-Kr but not in He-He and Ne-Ne collisions is offered. (auth)

1114 EXCITATION OF HELIUM BY 20 TO 100 keV HYDROGEN ATOMS. Blair, W.G.F.; Gilbody, H. B. (Queen's Univ., Belfast). J. Phys., B (London); 6: No. 3, 483-492(Mar 1973).

The excitation of helium by 20 to 100 keV hydrogen atoms has been investigated by the spectroscopic analysis of radiation emitted in the spectral range 3900 to 6000 Å during the spontaneous decay of the excited products of single collisions. Absolute cross sections for the excitation of the 4^1S, 4^1D, 4^3S and 4^3D levels have been determined. In the case of the 4^1S and 4^1D levels, cross sections for excitation by protons and hydrogen atoms have been compared with a relative accuracy of ±12%. The measured cross sections are in generally poor accord with recent theoretical estimates. (auth)

1115 COULOMB EFFECTS IN THE FINAL STATE OF AN IONIZING COLLISION BETWEEN ELECTRONS AND HELIUM ATOMS. Salin, A. (Bordeaux Univ., Talence, France). J. Phys., B (London); 6: No. 3, L34-L36(Mar 1973).

The Coulomb interaction between the two electrons and residual ion in the final state of an ionizing collision between electrons and atoms is shown to influence the experimental findings of Ehrhardt et al. (J. Phys. B. Atom. Molec. Phys.; 5: 2107-15(1972)) for the triple differential cross section. (auth)

1116 COLLISIONS OF FAST ELECTRONS WITH HELIUM. 3. Excitation of the $(1s,nd)^1D$ and $(ns,mp)^1P$ States. Woollings, M. J.; McDowell, M.R.C. (Royal Holloway Coll., London). J. Phys., B (London); 6: No. 3, 450-461(Mar 1973).

A simplified second Born approximation together with a third order approximation have been used to calculate differential and total cross sections for the electron excitation of the 3^2D and 4^2D states of hydrogen, the 3^1D and 4^1D of helium, and of model doubly excited states of helium. Where possible, comparisons with experimental data are made. Large corrections occur to the first Born cross sections for the excitation of the model doubly excited states and it is suggested that these corrections may also be expected to the first Born results for simultaneous excitation and ionization. (auth)

1117 LOW-ENERGY POSITRONS FROM METALLIC MODERATORS IN BACKSCATTERING MODE. Pendyala, S.; Zitzewitz, P. W.; McGowan, J. W.; Orth, P.H.R. (Univ. of Western Ontario, London). Phys. Lett.; 43A: No. 3, 298-300(12 Mar 1973).

The energy spectra of thermalized positrons emitted in the backscattering mode from Cu, Au, and Al moderators are reported. (auth)

1118 RELATIVISTIC PHOTOEFFECT IN THE H_2 MOLECULE. Kaplan, I. G.; Markin, A. P. (Scientific-Research Physical-Chemical Inst., Moscow). Zh. Eksp. Teor. Fiz.; 64: No. 2, 424-437(Feb 1973). (In Russian).

The photoionization cross section of the H_2 molecule is calculated for ejected electrons with relativistic energies up to 1 MeV. The cross section is summed over all vibrational states of the H_2^+ ion.

A relativistic plane wave was employed as the ejected electron wave function. The ground state wave function for the H_2 molecule is set up in an approximation which is a relativistic extension of the Heitler–London method. (auth)

1119 SECOND BORN APPROXIMATION FOR IONIZATION. Tweed, R. J. (Queen's Univ., Belfast). J. Phys., B (London); 6: No. 3, 398-405(Mar 1973).

Expressions incorporating the correct phase factors are derived for the Born II scattering amplitude for ionization. The limiting behavior of this with small momentum transfer is considered, and an expression for the high energy behavior of the cross section, analogous to the Bethe approximation, is obtained. (auth)

1120 USE OF SECOND ORDER POTENTIALS IN THE THEORY OF THE SCATTERING OF CHARGED PARTICLES BY ATOMS. 4. Electron Scattering of Helium Atoms. Berrington, K. A.; Bransden, B. H.; Coleman, J. P. (Univ. of Durham, Eng.). J. Phys., B (London); 6: No. 3, 436-449(Mar 1973).

A method described previously (Bransden and Colemen, J. Phys. B. Atom. Molec. Phys.; 5: 537-45 (1972)) is applied to the scattering by helium atoms of electrons between 50 and 1000 eV, and results are presented for elastic scattering and the 2^1S and 2^1P excitation. It is found that the inclusion of second order potential terms leads to cross sections which are in significantly better agreement with the experimental data than those of previous calculations. (auth)

1121 PRODUCTION OF CHARACTERISTIC X RAYS BY PROTON BOMBARDMENT, AND THE RATIO OF CHARACTERISTIC TO CONTINUOUS RADIATION. Dyson, N. A. (Univ. of Birmingham, Eng.). J. Phys., B (London); 6: No. 3, 562-572(Mar 1973).

Absolute measurements of K and L characteristic x rays produced in thick targets of Ni, Cu, Mo, Ag, and W are reported. The data for K x rays are compared with a theoretical result obtained by integration of the expression for the cross section given by Merzbacher and Lewis (Encyclopaedia of Physics, pp 166-192(1958)). The expression for yield as a function of energy can be put into a very simple form without the need for an empirical function, and this is verified experimentally. A new absolute comparison can be made between thick-target theory and the present data for nickel and gives good agreement. Tungsten L-radiation is investigated, and spectra are obtained using a Si(Li) detector. The number of L-ionizations per proton in tungsten is found to be greater than the number of K-ionizations expected in an element with a K-shell binding energy equal to the L_{III} binding energy of tungsten, by a factor of 2.9. The proton bremsstrahlung is measured and the ratio of characteristic to continuous radiation found to be 1.63×10^3 for 420-kV protons on nickel. This is shown to be about 3 orders of magnitude greater than for electron bombardment under optimum conditions. (auth)

1122 CALCULATION OF VIBRATIONAL-ROTATIONAL TRANSITION MATRIX ELEMENTS FOR DIATOMIC MOLECULES BY USE OF A LINEAR VARIATIONAL TECHNIQUE AND THE APPLICATION OF THE METHOD TO THE CO MOLECULE, EFFECT OF TEMPERATURE IN GAS ELECTRON DIFFRACTION, THE TEMPERATURE DEPENDENCE OF THE FIRST FOUR MOMENTS OF A MORSE OSCILLATOR AND ON THE CALCULATION OF TOTAL ELECTRON INELASTIC SCATTERING CROSS SECTIONS FOR NEUTRAL ATOMS IN THE KEV ENERGY RANGE. Ng, E. K. Y. W. Bloomington, IN; Indiana Univ. (1972). 76p. University Microfilms Order No. 73-9771.

Thesis (Ph. D.).

Wave functions and energy levels for the vibrational-rotational Schroedinger equation, are obtained by use of the linear variational method based on the energy minimization of the weighted expection value of H, EMWH. The EMWH and the j-expansion schemes were applied to the CO molecule for j = 20, 21, 40, 41, 60, and 61. The effect of temperature on the first four moments of a Morse oscillator is investigated over the temperature range of 10°K to 1,500°K. Numerical calculations are carried out for parameters of the I_2 molecule. The total inelastic cross sections for electron scattering from neutral atoms are calculated by integrating the Morse inelastic intensity over all scattering angles using the Waller–Hartree values of the inelastic scattering factors given by Tavard. New calculations for the total inelastic electron scattering cross sections for the elements H, He, Ne, Ar, and Kr at incident electron energies of 500 eV and 40 keV are presented. (JFP)

1123 LINEAR POLARIZATION OF LOW ENERGY BREMSSTRAHLUNG. Kuckuck, R. W. Davis, CA; Univ. of California (1972). 124p. University Microfilms Order No. 73-8331.

Thesis (Ph. D.).

The linear polarization of low energy electron bremsstrahlung from thin targets (≤ 80 μg/cm²) of Al, Cu, Ag and Au has been measured for incident electron energies of 50, 75, and 100 keV. The polarization was measured as a function of photon energy at four emission angles (θ = 22.5, 45, 90 and 135°), using a Compton polarimeter with large asymmetry ratio (35 to 150) and a high resolution Ge(Li) spectrometer (550 eV FWHM for 60 keV photons). A brief discussion of the theoretical aspects of bremsstrahlung polarization, as well as a summary of calculational and experimental work to date, is presented. The Compton polarimeter is discussed in detail. The polarization data obtained here are compared to the predictions of various theories and, in particular, to the exact numerical bremsstrahlung calculation of Tseng and Pratt. (Diss. Abstr. Int., B)

1124 COMPARISON OF SEMI-CLASSICAL, EXACT QUANTUM, AND QUASI-CLASSICAL REACTIVE TRANSITION PROBABILITIES FOR THE COLLINEAR $H + H_2$ REACTION. Bowman, J. M.; Kuppermann, A. (California Inst. of Tech., Pasadena). Chem. Phys. Lett.; 19: No. 2, 166-170(15 Mar 1973).

The classical (CSC), primitive (PSC), and uniform (USC) semiclassical expressions for reactive transition probabilities of Miller and co-workers were used to obtain reaction probabilities for the collinear $H + H_2$ exchange reaction. Comparisons with exact quantum results for the $0 \rightarrow 0$ transition reveal that these semi-classical approximations are not very good, especially the CSC and PSC ones. The USC results are better, but the quasi-classical trajectory results give in average a more accurate description. For this transition, the extra effort required in going from the quasi-classical to the semi-classical probabilities did not produce an improvement in the results. For the $0 \rightarrow 1$ reactive transition the USC calculations are in fairly good qualitative agreement with the exact quantum results except for an upward shift of 0.08 eV in the effective threshold energy. They are somewhat better than the microscopically reversed quasi-classical ones. (auth)

1125 DEPENDENCE OF THE ENERGY PER ION PAIR ON THE PHOTON ENERGY BELOW 6 keV IN VARIOUS GASES. Srdoc, D. (Columbia Univ., New York). Nucl. Instrum. Methods; 108: No. 2, 327-332(1973).

An attempt has been made to measure W(E), i.e. the energy required for formation of an ion pair, as a function of photon energy in various gases. The method consists in performing accurate measurements of pulse height spectra of K lines of low Z elements using a proportional counter. The W values obtained in the energy range from 277 to 5890 eV did not depart more than +3% and −1% from the value measured at 5890 eV in four investigated gases: Ar + 10% CH_4, C_3H_8 and two tissue equivalent gas mixtures. Below the carbon K line (277 eV) the incident photon beam consisted of a narrow band of soft X-rays obtained by filtration of bremsstrahlung. The mean energy as well as the width of the filtered X-ray spectrum were calculated. The measurement of W(E) in propane revealed a steady increase of W below 200 eV. (auth)

1126 PENNING ELECTRON SPECTROSCOPY AT VERY HIGH KINETIC ENERGIES: $He^*(Ne^*) + Xe \rightarrow He(Ne) + Xe^+ + e^-$ AND $He^* + Ar \rightarrow He + Ar^+ + e^-$. Coleman, M. L. (Massachusetts Inst. of Tech., Cambridge); Hammond, R.; Dubrin, J. W. Chem. Phys. Lett.; 19: No. 2, 271-273(15 Mar 1973).

Electron energy spectra from the ionization of Xe by fast (ca. 10 to 100 eV) He and Ne metastables and Ar by He metastables were measured and are compared with the corresponding thermal (ca. 0.1 eV) results. (auth)

1127 DESCRIPTION OF AN APPARATUS FOR STUDYING EXCITATION IN ELECTRON–ATOM COLLISIONS BY THE ELECTRON–PHOTON COINCIDENCE METHOD. Pochat, A.; Gelebart, F.; Doritch, M.; Peresse, J. (Univ., Brest, France). Analusis; 1: No. 5, 368-373(Oct 1972). (In French).

An apparatus is described for studying excitation in electron-atom collisions. A photon emitted by the excited atom is detected in coincidence with the inelastically scattered electron at a given angle. Preliminary results are given for the lifetime of the 4^1S state of helium. (FR)

Atomic Theory

Refer also to abstract 1353.

1128 RECOIL CORRECTIONS IN A STRONG NUCLEAR FIELD. Braun, M. A. (Leningrad State Univ.). Zh. Eksp. Teor. Fiz.; 64: No. 2, 413-423(Feb 1973). (In Russian).

Corrections to atomic levels of the order of 1/M (M is the nuclear mass) are considered for the case of a large nuclear charge ($Z\alpha \sim 1$). An explicit expression is found for the additional interaction and self-action of electrons due to slow movement of the nucleus. A simple closed expression for corrections of the order of 1/M to the atomic levels is obtained in the lowest order in α. (auth)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

1129 EXPLICIT SECOND ORDER METHOD OF CHARACTERISTICS FOR QUASILINEAR HYPERBOLIC DIFFERENTIAL EQUATIONS AND APPLICATIONS. Demmig, F. (Technische Univ., Hanover). Comput. Phys. Commun., 4: No. 2, 186-192(Nov 1972).

An explicit second order method of characteristics is given for the numerical solution of initial boundary value problems for quasilinear hyperbolic first order systems of partial differential equations with two independent variables and its application in fluid dynamics. (auth)

1130 REPORT ON THE NATO ADVANCED STUDY INSTITUTE ON MAGNETOHYDRODYNAMIC PHENOMENA IN ROTATING FLUIDS. Moffatt, H. K. (ed.) (Dept. of Applied Mathematics and Theoretical Physics, Cambridge, Eng.). J. Fluid Mech.; 57: No. 4, 625-649(6 Mar 1973).

A meeting held at Cambridge, England, from 26 June to 4 July 1972 entitled "Magnetohydrodynamic Phenomena in Rotating Fluids" covered aspects of the geophysics of the earth's core and of astrophysics in which both rotation effects and magnetic effects play an important part. The main sessions were entitled: The earth's magnetism and planetary magnetism, convection, differential rotation, and magnetohydrodynamics in the sun, stellar and interstellar magnetism, pulsars, boundary layers and detached shear layers and spin-up problems, waves and instabilities influenced by Lorentz and/or Coriolis forces, Dynamo theory. (UK)

PHYSICS (HIGH-ENERGY)

Refer also to abstract 1961.

Particle Interactions and Properties (Experimental)

Refer also to abstract 1310.

1131 (BMBW-FBK-72-21) ANNUAL REPORT, 1971. (Hamburg Univ. (West Germany). II. Institut fuer Experimentalphysik). Nov 1972. 108p. (In English and German). Dep. NTIS (U. S. Sales Only).

In nuclear physics mainly reaction mechanisms, nuclear moments, and hyperfine interactions are studied. The experiments are done by means of the Hamburg 30 MeV-isochronous cyclotron (HAZY), a 3 MeV van de Graaf-generator, and radioactive sources. Elementary particle physics and solid state physics are done in close connection with corresponding research groups at DESY. Research is focussed on production processes and reaction mechanisms of elementary particles, and on the optical properties of solids in the far ultraviolet region by means of the synchrotron radiation of DESY. (auth)

Electromagnetic

1132 (JINR-E13-6749) EXPERIMENTAL SETUP IN A π^-–e SCATTERING EXPERIMENT AT 50 GeV/c. Adylov, G. T.; Aliev, F. K.; Filippov, P. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1972. 32p. Dep. NTIS (U. S. Sales Only) $3.75.

The experimental setup and apparatus used to measure pion-electron elastic differential cross sections $d\sigma/dt$ for $0.015\ (\mathrm{GeV/c})^2 \leq t \leq 0.036\ (\mathrm{GeV/c})^2$ are described. The details of the overall performance of the equipment and the experimental method are discussed. (auth)

1133 POLARIZATION OF PROTONS PRODUCED IN THE $\gamma + p \rightarrow \pi^0 + p$ REACTION BY 692 TO 1028 MeV PHOTONS AT AN ANGLE OF 90° IN THE C.M.S. Goncharov, N. V.; Derebchinskii, A. I.; Zybalov, A. A.; Konovalov, O. G.; Tenishev, A. E.; Tonapetyan, S. G.; Khvorostyan, V. M. (Physical Technical Inst., Kharkov). Zh. Eksp. Teor. Fiz.; 64: No. 2, 401-406(Feb 1973). (In Russian).

The polarization of recoil protons produced in the $\gamma + p \rightarrow \pi^0 + p$ reaction by 692 to 1028 MeV γ quanta at an angle of 90° in the c.m.s. is measured with an energy resolution $\Delta E_\gamma = 13$ to 22 MeV. The polarization is found to depend strongly on the energy resolution. A minimum in the energy dependence of polarization is observed for photon energies of 900 to 1000 MeV. For photon energies up to 900 MeV satisfactory agreement between the experimental data and isobar model calculations of Walker is observed. At higher energies the calculated polarization values are not in agreement with the experimental values. (auth)

1134 π^--MASS AND VACUUM POLARIZATION. A Re-evaluation. Backenstoss, G.; Daniel, H.; Koch, H.; Von der Malsburg, Ch.; Poelz, G.; Povel, H. P.; Schmitt, H.; Tauscher, L. (CERN, Geneva). Phys. Lett.; 43B: No. 6, 539-541.

The π^--mass and vacuum polarization measurements of the CERN-Karlsruhe-Heidelberg group were re-evaluated. The π^--mass is found to be 139.569 ± 0.008 MeV. A new value of the muonic neutrino rest mass is deduced to be $m_\nu^2 = -0.29 \pm 0.90\ \mathrm{MeV}^2$. (auth)

Weak

1135 MEASUREMENT OF THE CHARGE ASYMMETRY IN $K_L^0 \rightarrow \pi^\pm e^\mp \nu$ DECAYS. Webb, R. C. Princeton, NJ; Princeton, Univ. (1972). 95p. University Microfilms Order No. 73-9660. Thesis (Ph. D.).

Using a magnetic spectrometer with multiwire proportional chambers for track definition, approximately $96(10^6)$ $K_L^0 \rightarrow \pi^\pm e^\mp \nu$ events were observed. From these K_{e3} decays the asymmetry in the decay rates for the two charge configurations was measured. This asymmetry was observed with three different mass configurations in the detector and an extrapolation to zero mass was performed. The result of this measurement is $\delta = (2.66 \pm .34)10^{-3}$. In terms of the parameters ϵ usually used to parameterize CP violation in the neutral K system this result leads to a measure of $\mathrm{Re}^\epsilon = (1.33 \pm .17)10^{-3}$ in the limit that $\Delta S = -\Delta Q$ amplitudes are zero. The most recent results for $|\eta_{+-}|$, $|\eta_{00}|$, and their phases, ϕ_{+-} and ϕ_{00}, lead to a predicted $\mathrm{Re}\epsilon$ of, $\mathrm{Re}\epsilon = (1.45 \pm .09)10^{-3}$. (Diss. Abstr. Int., B)

1136 EXPERIMENTAL MEASUREMENT OF THE CP VIOLATION PARAMETER $|\eta_{00}/\eta_{+-}|^2$ IN $K^0 \rightarrow 2\pi$ DECAYS. Knapp, B. C. Princeton, NJ; Princeton Univ. (1972). 103p. University Microfilms Order No. 73-9618.

Thesis (Ph. D.).

An optical spark chamber experiment at the Brookhaven AGS has measured the absolute square ratio of the CP violation parameters η_{00} and η_{+-}, defined in terms of the K_L and K_S decay rates to be: $|\eta_{00}/\eta_{+-}|^2 = \Gamma(K_L \rightarrow \pi^0\pi^0)\Gamma(K_S \rightarrow \pi^+\pi^-)/\Gamma(K_S \rightarrow \pi^0\pi^0)\Gamma(K_L \rightarrow \pi^+\pi^-)$. Observation of $\pi^0\pi^0$ and $\pi^+\pi^-$ decays of K_L in vacuum and of K_S regenerated by eight inches of uranium provided $|\eta_{00}/\eta_{+-}|^2 = 1.06 \pm .21$. (Diss. Abstr. Int., B)

1137 DETERMINATION OF THE DIFFERENCE OF PHASE BETWEEN $\eta_{00} = A(K_L \rightarrow \pi^0\pi^0)/A(K_S \rightarrow \pi^0\pi^0)$ AND $\eta_+ = A(K_L \rightarrow \pi^+\pi^-)/A(K_S \rightarrow \pi^+\pi^-)$. Barbiellini, G.; Darriulat, P.; Fainberg, A.; Holder, M.; Maderni, G.; Orito, S.; Radermacher, E.; Rubbia, C.; Staude, A.; Strolin, P.; Tittel, K. (CERN, Geneva). Phys. Lett., B; 43B: No. 6, 529-534(19 Mar 1973).

The phase of the ratio η_{00}/η_+ was determined combining interference studies behind copper regenerators for $K_{L,S} \rightarrow \pi^0\pi^0$ and $K_{L,S} \rightarrow \pi^+\pi^-$ decays. The result, independent of the regeneration mechanism and $K_{L,S}$ decay parameters, is $\phi_{00} - \phi_+ = 7.6° \pm 18°$. The experiment, compatible with $\phi_{00} = \phi_+$, sets an upper limit to the T-conserving, CPT-violating amplitude in K° decays. (auth)

Strong (Baryon-induced)

1138 (INR-1445) PRODUCTION OF HYPERNUCLEI WITH MASS NUMBERS 4 AND 5. Filipkowski, A. (Institute of Nuclear Research, Warsaw (Poland)). 1972. 16p. Dep. NTIS (U. S. Sales Only) $3.00.

An analysis was made of the hypernucleus production in the absorption at rest of K^- mésons on light emulsion nuclei, C, N, O. Experimental data are presented on the frequency of emission of charged π mesons accompanying various hypernuclear species. Energy distributions and, wherever possible, signs of π meson charges are given for ^{4}H, ^{4}He and ^{5}He hypernuclei. (auth)

1139 ENERGY DEPENDENCE OF THE PROTON–PROTON TOTAL CROSS-SECTION FOR CENTER-OF-MASS ENERGIES BETWEEN 23 AND 53 GeV. Amaldi, U. (Instituto Sueriore di Sanita, Rome); Biancastelli, R.; Bosio, C.; Matthiae, G.; Allaby, J. V.; Bartel, W.; Cocconi, G.; Diddens, A. N.; Dobinson, R. W.; Wetherell, A. M. Phys. Lett., B; 44B: No. 1, 112-118(2 Apr 1973).

Measurements of proton–proton elastic scattering at angles around 6 mrad were made at centre-of-mass energies of 23, 31, 45 and 53 GeV using the CERN Intersecting Storage Rings. The absolute scale of the cross section was established by determination of the effective density of the colliding beams in their overlap region. Proton–proton total cross sections were deduced by extrapolation of the elastic differential cross section to the forward direction and by application of the optical theorem. The results indicate that over the energy range studied the proton–proton total cross section increases from about 39 to about 43 mb. (auth)

1140 MEASUREMENT OF THE TOTAL PROTON–PROTON CROSS SECTION AT THE ISR. Amendolia, S. R. (Istituto Nazionale di Fisica Nucleare, Pisa, Italy); Bellettini, G.; Braccini, P. L. Phys. Lett.; 44B: No. 1, 119-124(2 Apr 1973).

The first results of a measurement of the total cross-section σ_T in proton–proton collisions at equivalent laboratory momenta between 291 and 1480 GeV/c at the CERN Intersecting Storage Rings (ISR) are presented. The method is based on the measurement of the ratio of the total interaction rate and the machine luminosity. The data show an increase of about 10% in σ_T in this energy interval. (auth)

1141 USE OF EXTRACTED SYNCHROCYCLOTRON BEAM TO INVESTIGATE SCATTERING OF 1-GeV PROTONS BY NUCLEI. Belostotskii, S. L.; Alkhazov, G. D.; Amal'skii, G. M.; Vorob'ev, A. A.; Dotsenko, Yu. V. (Leningrad Inst. of Nuclear Physics). JETP Lett. (USSR) (Engl. Transl.); 17: No. 2, 69-71(20 Jan 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 2, 101-102(20 Jan 1973).

The energy spectra of protons with initial energy of 1 GeV scattered by calcium-40 using a synchronization technique are shown. (JFP)

1142 NEUTRON PROTON CHARGE EXCHANGE SCATTERING FROM 8 TO 29 GeV/c. Davis, M. B. Princeton, NJ; Princeton Univ. (1972). 137p. University Microfilms Order No. 73-9603.

Thesis (Ph. D.).

The differential cross sections for neutron proton charge exchange scattering were measured for incident neutron momenta between 8 and 29 GeV/c and for four-momentum transfers $|t|$ between 0.002 and 1.0 $(GeV/c)^2$. A neutron beam with a broad momentum spectrum was scattered from a liquid hydrogen target. The momenta and scattering angles of the forward-scattered protons were measured by a spark-chamber magnet spectrometer. The times of flight and scattering angles of the recoil neutrons were measured by a bank of thick scintillation counters. The efficiencies of the neutron counters were determined in a separate measurement. Absolute normalization of the data was obtained from a measurement of the diffraction dissociation of neutrons from carbon nuclei. Differential cross sections, based on ~23,000 events, are presented for 9 different momenta. The shape of the differential cross sections and the momentum dependence are examined in detail. (Diss. Abstr. Int., B)

1143 $\bar{P}P$ ANNIHILATIONS INTO FOUR CHARGED MESONS AT 1.6 TO 2.2 GeV/c. Davidson, J. A. Jr. Ann Arbor, MI; Univ. of Michigan (1972). 163p. University Microfilms Order No. 73-6815.

Thesis (Ph. D.).

From an exposure of the ANL 30-inch hydrogen bubble chamber to antiprotons at beam momenta (total invariant mass) 1.63(2300), 1.77(2349), 1.83(2371), 1.88(2388), 1.95(2413), and 2.20 GeV/c (2500 MeV), the following reactions were analyzed: $\bar{p}p \rightarrow \pi^-\pi^-\pi^+\pi^+$ (1), $\bar{p}p \rightarrow \pi^-\pi^+K^-K^+$ (2), and $\bar{p}p \rightarrow K^-K^-K^+K^+$ (3). Cross sections as a function of momentum are presented. The percentage of resonance production in reaction (1) is examined using the maximum likelihood (ML) method. The channel is dominated by $\rho\pi\pi$ and ρf production. The percentage of ρf decreases with $\bar{p}$ momentum, while $\rho\pi\pi$ appears to increase. In the center-of-momentum (CM) frame, a forward-backward peaking is seen in the $\cos(\theta)$ distribution of the pions. The forward-backward and polar-equatoral ratios are found to increase with pion momentum. The spin density matrix elements are examined in the Gottfried-Jackson and helicity frames both as a function of $\pi^+\pi^-$ mass and the squared four-momentum transfer. A study is made of ρ-ω interference in the $\pi^+\pi^-$ mass spectrum. Bubble density information is used to select events consistent with reaction (2). ML fits are made; the reaction is dominated by $K^*K\pi$, $\varphi\pi\pi$, and ρKK production. An enhancement is seen in the Q region of the $\pi\pi K$ mass spectrum at 1278 MeV with a FWHM of 25 MeV. The CM $\cos(\theta)$ distributions for the $2\pi 2K$ reaction have forward-backward peaks. After bubble density selection, six events are consistent with reaction (3). Mass spectra indicate that five events have at least one φ meson produced; one of these is a $\varphi\varphi$ event. (Diss. Abstr. Int., B)

1144 OBSERVATION OF THE ABC EFFECT IN THE REACTION $d + d \rightarrow \alpha + (mm)^0$. Banaigs, J. (CEN, Saclay, France); Berger, J.; Goldzahl, L.; Risser, T.; Vu-Hai, L.; Cottereau, M.; Le Brun, C.; Fabbri, F. L.; Picozza, P. Phys. Lett.; 43B: No. 6, 535-538(19 Mar 1973).

The reaction $d + d \rightarrow \alpha + (mm)^0$ where the missing mass system is in a pure state of isospin I = 0 is studied using 2.49 GeV/c incident deuterons and the missing mass technique. The ABC effect is observed, dominating the missing mass spectrum with a production cross section of 0.66 μb/sr at zero degrees in the center of mass system. (auth)

Strong (Meson-induced)

1145 (COO-3130-TB-165) BACKWARD πN CHARGE EXCHANGE AT 4.3 GeV/c AND 6.0 GeV/c. Chen, G. T. Y. (Brown Univ., Providence, R. I. Dept. of Physics). Jun 1972. Contract AT(11-1)-3130. 128p. Dep. NTIS $8.50.

Thesis.

The preliminary analysis of the reaction $\pi^-p \rightarrow n\pi^0$ in the backward hemisphere at incident pion momenta of 4.3 and 6.0 GeV/c is described. We have measured the angular distribution over the u interval $u_{max} > u > -.9$ GeV^2 at 6.0 GeV/c, and $u_{max} > u > -.6$ GeV^2 at 4.3 GeV/c. Counters and optical spark chambers were used to detect the reaction and decay particles. The two energies covered are part of a comprehensive sweep of the intermediate energy region in the study of backward charge exchange. The methods of analysis used are discussed. (auth)

1146 (JINR-E1-6994) ESTIMATE OF ELASTIC π^-p AND COHERENT π^-C INTERACTION CROSS SECTIONS AT 40 GeV/c. Jancso, G.; Kohli, J. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 16p. Dep. NTIS (U. S. Sales Only) $3.00.

Results regarding the elastic and coherent production cross sections in π^-p and π^-C interactions at pc = 40 GeV are presented. (auth)

1147 (LBL-1052) OBSERVATION OF FORWARD PEAKS IN $\pi^+n \rightarrow K^0Y^{*+}(1385)$ AND IN RELATED SINGLE-MESON-EXCHANGE-FORBIDDEN REACTIONS. Hoch, P. L. (California Univ., Berkeley. Lawrence Berkeley Lab). 16 Oct 1972. Contract W-7405-eng-48. 199p. Dep. NTIS $12.00.

Thesis.

The production of decouplet-baryon resonances [$Y_1^*(1385)$, $\Xi^*(1530)$, and $\Delta(1236)$] in reactions which cannot proceed by the exchange of any single known meson was studied. These exotic exchange reactions were examined at incident momenta ranging from 1.8 to 4 GeV/c, using data from several bubble chamber exposures. In all but one of the reactions studied, there is significant "forbidden" forward peaking. At roughly 2 to 3 GeV/c, the cross section in the forward direction is 2 to 7 μb/sr for $\pi^-p \rightarrow K^+Y^{*-}$ and $K^-p \rightarrow K^+\Xi^{*-}$, ≈20 μb/sr for $K^-p \rightarrow \pi^+Y^{*-}$, and ≈100 μb/sr for $\pi^-p \rightarrow \pi^+\Delta^-$; no peak is seen in $K^-p \rightarrow K^0\Xi^{*0}$. A decrease with energy is evident. The data are presented at length to establish the existence of the forbidden peaking in final states which are dominated by other features; production and decay distributions are given. Various possible explanations of forbidden peaking are reviewed. We argue that Berger's model does not explain away the peaking as a kinematic reflection. Recent work suggests that two-meson exchange may provide an explanation. We also consider the possible roles of exchange of a single (exotic) meson and of direct-channel resonance formation. (auth)

1148 S- AND P-WAVE PHASE SHIFTS OF THE I = 3/2 $K^-\pi^-$ ELASTIC SCATTERING. Amsterdam-Nijmegen Collaboration. pp 57-60 of Meson Resonances and Related Electromagnetic Phenomena. Dalitz, R. H. (ed.). Bologna; Editrice Compositori (1972).

From International Conference on Meson Resonances and Related Electromagnetic Phenomena; Bologna, Italy (14 Apr 1971). See CONF-710421-.

Spherical harmonic moments, cross sections, and phase shifts for $K^-\pi^-$ elastic scattering were determined from the K^- angular distribution in the reaction $K^- + p \rightarrow p + \pi^+ + K^- + \pi^-$. (JFP)

Particle Interactions and Properties (Theoretical)

1149 VZAIMODEISTVIYA VYSOKOENERGETICHESKIKH CHASTITS I ATOMNYKH YADER S YADRAMI. (Interactions of High Energy Particles and Atomic Nuclei with Nuclei). Barashenkov, V. S.; Toneev, V. D. Moscow; Atomizdat (1972). 648p.

The strong interactions of elementary particles and atomic nuclei are examined at energies of from several tens of MeV's to the ultrahigh energies of several thousand GeV's. Processes associated with intranuclear cascades, inelastic scattering cross sections, and strongly excited nuclei after passage though a cascade avalanche are considered. "Boil-off", fragmentation, and decay of excited residual nuclei, and the process of nuclear fission are discussed. The book is replete with tables of data and graphs both theoretical and experimental in origin pertinent to high-energy studies. (1533 references) (KSW)

General

1150 DESCRIPTION OF UNSTABLE PARTICLES IN THE N-Θ AND V-Θ-SECTORS OF THE LEE MODEL. Luchnikov, L. A. Teor. Mat. Fiz.; 15: No. 1, 100-106(Apr 1973). (In Russian).

The description of unstable particles and unstable systems is proposed, which is based on matrices of the transition from the Schrödinger basis to the Heisenberg basis. The obtained results can be useful in investigating the resonant final states of interacting particles and also for derivation of the angular distribution, energy dependence and polarization distribution of the stimulated radiation. (auth)

1151 MULTIPLICITY DISTRIBUTION IN THE CENTRAL REGION. Cheng, K. S.; Wang, J. M. (State Univ. of New York, Stony Brook). Phys. Lett.; 44B: No. 1, 88-90(2 Apr 1973).

Multiplicity distributions in a finite section of momentum space of the central region are discussed. It is pointed out that experiments which concentrate on such finite regions are more likely to discriminate between the independent emission model and the fragmentation model. (auth)

1152 HIGH-ENERGY SCATTERING PROCESSES. Benecke, J. (Max-Planck-Institut for Physik und Astrophysik, Munich). Umschau; 71: No. 13, 478-480; 482-484(1971). (In German).

The following general characteristics of particle production

in high-energy scattering processes are described: (1) the inelastic portion of the effective cross section is predominant; (2) the mean particle number increases logarithmically with the primary energy; (3) the effective cross sections are not affected by the energy; (4) the distribution of the transverse momentum of the secondary particles is not affected by the energy; and (5) in elastic reactions, the momentum distribution assumes a limit at high primary energy. Some models are mentioned that can be used to interpret the measured data. (LBS)

1153 EXPONENTIAL INTERACTIONS AT HIGH ENERGY. Horvath, Z.; Pocsik, G. (Roland Eoetvoes Univ., Budapest). Acta Phys. Pol., B; B4: No. 2, 211-217(1973).

It is shown that the exponential interaction exp z^2 leads to Regge-type high energy elastic scattering amplitudes when summations are carried out in the major coupling constant. A more complicated entire interaction of the same order yields similar results. (auth)

1154 UNIFIED SPACE-TIME FOR INTERACTION OF ELEMENTARY PARTICLES. Tran Hu'u Phat (Inst. of Theoretical Physics, Warsaw). Acta Phys. Pol., B; B4: No. 2, 193-209(1973).

The eight-dimensional space-time is utilized for establishing the elementary particles theory free of the ultraviolet infinities. The main results are as follows. A procedure for evaluating the mean values with respect to the directly unobservable parameters is introduced. Although it is formally equivalent to the nonlocality introduced previously the theory is still microcausal and the S-matrix is unitary on the mass shell. In addition, particles are classified in multiplets; the same internal space may be used for both types of particles, leptons and hadrons. It is shown that the Yukawa interaction is deducible from the local gauge transformations in unified space-time. The interaction Lagrangians of strong interactions and of leptonic interactions are established. (auth)

1155 PARTICLE PHYSICS: AN INTRODUCTION. Leon, M. New York; Academic Press, Inc. (1973). 277p. $14.50.

A selective introduction to topics in particle physics is presented with emphasis on the organizing principles. The first three chapters develop the use of relativity and quantum mechanics to describe scattering and decay, wave equations, the s-matrix, and the connection between symmetries and conservation laws. Chapter 4 introduces field theory. Field operators and Feynman rules are applied in Chapter 5 to quantum electrodynamics, with a descriptive discussion of the divergences of higher order processes and renormalization. Chapters 6-9 mainly concern the phenomenology of pions and nucleons, but continue to bring in more important theoretical ideas. Chapter 10 concerns SU(3) and the quarks, while Chapter 11 surveys the weak interactions, ending with the phenomena connected with K^0 decay. Finally, Chapter 12 discusses topics in strong interaction dynamics, introducing dispersion relations and Regge poles. (LBS)

1156 SCATTERPLOTS AND PHASE SPACE DISTRIBUTIONS IN INVARIANT VARIABLES FOR THREE-PARTICLE FINAL STATES. Nyborg, P. (Norges Landbrukshoegskole, Vollebekk, Norway); Frodesen, A. G. Phys. Norv.; 6: No. 2, 67-76(1972).

The description of three-particle final states is discussed, using a series of two-dimensional projections (scatterplots), in invariant variables, of the five-dimensional phase space. Properties of the various projections are derived from analytical phase space formulae. The results obtained are visualized by computer-generated phase space events, using the Monte Carlo technique with a standard set of integration variables. It turns out that, in addition to the Dalitz plot and the Chew-Low plot, other plots provide possibilities for presentation and evaluation of experimental data. (auth)

1157 PARITY AND TIME REVERSAL IN THE GRAVITATIONAL INTERACTION, AND THE POSSIBLE EXISTENCE OF A MASSLESS SCALAR PARTICLE. Hayashi, K. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Phys. Lett.; 43B: No. 6, 497-501(19 Mar 1973).

Assuming general covariance, the gravitational interactions among the proton and the electron are discussed, and it is shown that any deviation from Einstein's gravitational theory inevitably involves hypothetical massless scalar particles, represented by skew symmetric field, in the weak-field limit. The result is compared with matrix element of the energy-momentum tensor in special relativity. (auth)

Electromagnetic

Refer also to abstract 1529.

1158 (COO-3533-13) ETA → 3π IN A RENORMALIZABLE SU(3) SIGMA MODEL. Hudnall, W.; Schechter, J. (Syracuse Univ., N. Y. Dept. of Physics). Jan 1973. 28p. (SU-4205-13). Dep. NTIS $3.50.

The problem of predicting the $\eta \to 3\pi$ decay rate in terms of the $K^+ - K^0$ mass difference is discussed in the framework of a renormalizable SU(3) sigma model. Order of magnitude agreement for the process is finally achieved. In addition, some connections with unified weak-electromagnetic guage schemes are explored. (auth)

1159 (JINR-E2-6953) TRANSITION MAGNETIC MOMENTS OF HADRONS AND SIDEWISE DISPERSION RELATIONS. Bluvstein, R. E.; Dubovik, V. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 16p. Dep. NTIS (U. S. Sales Only) $3.00.

The system of the linear relations for the nucleon and transition magnetic moments $\mu_{\omega\pi\gamma}$, $\mu_{\rho\pi\gamma}$ and $\mu_{N^*_{1470}N\gamma}$ is obtained on the basis of the sidewise dispersion relation in the one-pion approximation. In such an approach the magnetic moments of the transition $\omega(\rho) \to \pi\gamma$ and $N^*_{1470} \to N\gamma$ are expressed in terms of the anomalous magnetic moments of nucleon and the strong interaction coupling constants. (auth)

1160 REGGEIZATION OF THE PHOTON IN QUANTUM ELECTRODYNAMICS. Pancheri-Srivastava, G. (CNEN, Frascati, Italy). Phys. Lett.; 44B: No. 1, 109-111(2 Apr 1973).

Under certain assumptions it is shown that in massless QED the photon may reggeize. Our technique involves a comparison of the infrared spectrum with that of the di-triple Regge expansion of inclusive processes. (auth)

1161 LIGHT CONE AND FIXED MASS LIMITS. Jersak, J. (Univ., Bern); Leutwyler, H.; Stern, J. Phys. Lett.; 44B: No. 1, 105-108(2 Apr 1973).

A hypothesis connecting high energy fixed mass limits of current amplitudes with the leading light cone singularity of current commutators is formulated. It is indicated how this hypothesis can be applied to various semi-hadronic processes. (auth)

1162 ELECTROMAGNETIC DECAYS OF $X^0(960)$ AND E(1420) MESONS. Khoze, V. A.; Nagorskaya, I. A.; Zaslavskii, A. N. (Erevan Physical Inst.). Acta Phys. Pol., B; B4: No. 2, 161-165 (1973).

The electromagnetic decays of the $X^0(960)$ and E(1420) mesons are studied. Decays with Dalitz pair production are analyzed in detail. (auth)

1163 FORMULATION OF BETHE-SALPETER EQUATION IN ELECTRON-PROTON DEEP INELASTIC SCATTERING. Lau, W. Y. Minneapolis; Univ. of Minnesota (1972). 103p. University Microfilms Order No. 73-10,669.

Thesis (Ph. D.)

Using perturbation theory for a model of pseudo scalar mesons coupled to the proton, the hadronic part of the amplitude is calculated for a set of dominant diagrams in e-p deep inelastic scattering. In particular, working in an infinite momentum frame, the structure function $\nu W_2(\nu, q^2)$ is calculated. The method is to set up a Bethe-Salpeter equation for the hadronic scattering amplitude, from which an integral equation for the imaginary part of that amplitude is derived. For large ω, $\nu W_2(\nu q^2)$ was found explicitly in the Bjorken limit. The result shows that $\nu W_2(\nu, q^2)$ is non-scaling, supporting the calculation of Chang-Fishbane for a similar model. On the other hand, it is also found that, by introducing a lower bound X_{min} in the integral equation for the spectral function, the scaling property of νW_2 can be revived in the same form as that obtained by Drell et. al., who used a different method of approach and different assumptions. (Diss. Abstr. Int., B)

1164 RESONANCE MODEL FOR DEEP INELASTIC ELECTRON PROTON SCATTERING AND ELECTRON POSITRON ANNIHILATION. Dahmen, H. D.; Steiner, F. (CERN, Geneva). Phys. Lett.; 43B: No. 6, 521-525(19 Mar 1973).

A resonance model for deep inelastic ep scattering and e^+e^- annihilation is studied making use of a generalized crossing relation. Scaling in deep annihilation is predicted and the scaling function $\bar{F}_2$ in this region is given. The multiplicity stays finite in this model except for the limiting case of vanishing slope of the trajectory of the resonance widths where the multiplicity grows logarithmically. (auth)

Weak

1165 LIGHT CONE CONSTRAINTS AND TWO ASYMPTOTIC DOMAINS IN LEPTON-NUCLEON AND MESON-NUCLEON SCATTERING. Das, T.; Pandit, L. K.; Roy, P. (Tata Inst. of Fundamental Research, Bombay). Phys. Lett.; 44B: No. 1, 76-70(2 Apr 1973).

Effective bare masses of the "current-quarks" are estimated from some testable inequalities, linking deep inelastic lepton-nucleon structure functions and high energy meson-nucleon total cross sections, derived on the basis of the light-cone commutators of the pseudoscalar densities of quark-field theory. (auth)

Strong (General)

1166 (COO-3533-11) SU(3) BREAKING AND PARTICLE PRODUCTION. Amann, R. F.; Blackmon, M. L. (Syracuse Univ., N. Y. Dept. of Physics). Dec 1972. 13p. (SU-4205-11). Dep. NTIS $3.00.

The effects upon measured particle production ratios of the electromagnetic and weak decays of directly produced particles are discussed. The importance of η production as a source of γ's, and of K_S production as a source of $\pi^{\pm}$'s, is discussed. The f-dominated Pomeranchukon model is explored as a possible source of η and K suppression. The predicted suppressions are however only of order 0.6; thus η and K production are predicted to be important at high energies, and, consequently, $\langle n_\gamma \rangle$ is predicted to significantly exceed $\langle n_{\pi^0} \rangle + \langle n_{\pi^-} \rangle$ at high energy. (auth)

1167 (DESY-73/1) DYNAMICS OF MULTIPLE REGGEON EXCHANGE CUTS. Craigie, N. S.; de la Torre, A. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Jan 1973. 34p. Dep. NTIS (U. S. Sales Only) $3.75.

The circumstances under which multiple pomeron exchange amplitudes can become iterative are discussed, and it is shown how the intermediate states involved in these amplitudes can be related to the states produced in diffractive dissociation. In order to obtain a soluble model, a simple integral equation is constructed, which in an iterative way leads to a multi-pomeron exchange series, including contributions of cut mechanisms involving spectator particles. From a particular solution of this equation it is illustrated how the longitudinal momentum distributions of the diffractive intermediate states influence the relative strength of the cuts. Further from a qualitative analysis, it is shown why one might expect the helicity nonflip vacuum amplitudes to have strong cuts, while all other amplitudes have weak cuts. A number of related points are also discussed. (auth)

1168 (JINR-E2-6936) SINGULAR POTENTIALS AND THEIR APPLICATIONS TO COMPOSITE MODELS OF HADRONS WITH INDEFINITELY RISING REGGE TRAJECTORIES. Filippov. A. T. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 20p. (CONF-721219-2). Dep. NTIS (U. S. Sales Only) $3.00.

The origin of singular potentials in polynomial and nonpolynomial field theories is briefly discussed. The basic properties of the Schroedinger equation with such potentials are considered in some detail with an emphasis on a new class of singular potentials which have a singularity for some finite value of r. These potentials (called FRS-potentials) are of particular interest for composite models of hadrons and seem to be connected with statistical bootstrap models. Some qualitative applications of FRS-potentials to composite models are briefly considered. (auth)

1169 VACUUM EXCHANGE IN THE THREE-REGGEON REGION. Pirogov, Yu. F. (Inst. of Physics, Erevan). Yadern. Fiz.; 16: No. 3, 628-629(Sep 1972). (In Russian).

A three-reggeon formula has been proposed to describe the asymptotic hadron distributions $a + b \to c + X$ near the kinematic boundary $s \gg M^2 \gg M^2$, where M represents the invariant mass of the beam and m the characteristic hadron mass. Comparison with spectral data revealed that the three-reggeon constant $\gamma(t)$ is too small and the secondary trajectory predominates. However, the derived formula does not take into account the interference effects due to vacuum and secondary trajectories. In this connection, processes which allow the vacuum exchange were examined on the basis of the two-component duality hypothesis, determining the contribution of diffraction, interference and non-diffraction type generation of the background and resonances. The calculations explained the low value of the diffraction generation of the background. The resonances are generated predominantly asymptotically near the boundary of the phase volume at very low values of t. Further experimental data are needed for more accurate calculations. (TTT)

1170 PROPOSAL TO OBSERVE THE VAN DER WAALS FORCE IN HADRON-HADRON SCATTERING. Sawada, T. (Tokyo Univ. of Education). Phys. Lett.; 43B: No. 6, 517-520 (19 Mar 1973).

Effect of the strong "Van der Waals force" on the scattering amplitudes of collision of hadrons, which are regarded as magnetically neutral composites of dyons, is investigated. Similarity between the high energy limit of the amplitude due to the Van der Waals interaction and the Pomeron exchange term is pointed out. Low energy experiments to detect the $(-t)^{\frac{1}{2}}$ singularity which is characteristic of the Van der Waals interaction are proposed. (auth)

1171 PADE APPROXIMATION AND ITS PHYSICAL APPLICATIONS. Basdevant, J. L. (CERN, Geneva). Fortschr. Phys.; 20: No. 5, 283-331(1972).

The Padé approximation, its mathematical features, and its practical and physical applications are reviewed. The present status of the convergence problem is described. Among the physical applications, particular emphasis is given to elementary particle theory. Various proofs of convergence are discussed, and it is shown why the approximation is particularly well suited for studying strong interaction dynamics. The various achievements of the approximation in the determination of $\pi\pi$, πN and NN scattering amplitudes are reviewed. (auth)

Strong (Baryon No. = 0)

Refer also to abstract 1144.

1172 (COO-3533-9) HIGH-ENERGY BEHAVIOR OF GAUGE THEORY TREE GRAPHS. Schechter, J.; Ueda, Y. (Syracuse Univ., N. Y. Dept. of Physics). Dec 1972. 12p. (SU-4205-9) Dep. NTIS $3.00.

The unitarity bounded high energy behavior of Born graphs for production of two massive vector mesons is shown to result from the decomposition of the amplitude into a locally gauge invariant part and a suppressed remainder. In addition, asymptotic helicity conservation is found to emerge. (auth)

1173 (COO-3533-12) POSSIBLE ZEROTH ORDER APPROXIMATION TO ELASTIC SCATTERING OF TWO PIONS. Frampton, P. H. (Syracuse Univ., N. Y. Dept. of Physics). Jan 1973. 9p. (SU-4205-12). Dep. NTIS $3.00.

A possible strong-interaction Born term for pion-pion scattering is suggested and discussed. (auth)

1174 (JINR-P2-6979) WARD CONFORMAL IDENTITIES AND π-MESON MASS RADIUS. Dao Vong Dyc (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 12p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The mass form factor of π-meson and its derivatives are considered in the framework of the conformal invariance theory. For this purpose the method is used based on the Ward identities introduced for T-products which include the scale and conformal currents. An estimate is obtained for the value of the π-meson mass radius. (auth)

1175 (NYO-3533-262) BOUNDS ON THE MOMENTS OF ABSORPTIVE PARTS OF ELASTIC SCATTERING AMPLITUDES. Balachandran, A. P.; Blackmon, M. L.; Sigaud, C. (Syracuse Univ., N. Y. Dept. of Physics). Nov 1972. 14p. (SU-4205-262). Dep. NTIS $3.00.

A rigorous set of bounds on the moments of the absorptive part of elastic scattering amplitudes and of its derivatives with respect to the cosine of the scattering angle is presented for pion-pion and pion-nucleon scattering. These bounds are similar to unitarity bounds found by Singh and Roy and involve integrals over absorptive parts and their derivatives in the physical scattering region only. (auth)

1176 LORENTZ CONTRACTED GEOMETRICAL MODEL. Krisch, A. D. (Univ. of Michigan, Ann Arbor). Phys. Lett.; 44B: No. 1, 71-75(2 Apr 1973).

The model assumes that when two high energy particles collide each behaves as a geometrical object which has a Gaussian density and is spherically symmetric except for the Lorentz-contraction in the incident direction. Folding the two spatial distribution together the slope (b) of the elastic diffraction peak is obtained in terms of the c.m. velocities (β_i and β_j) and the sizes (A_i and A_j) of the two incident particles. These sizes are assumed to have the experimental s-dependence of $\sigma_{tot} \propto \pi A^2$ for each reaction. The combined s-dependence of the σ_{tot}'s and the β's gives the s-dependence of the elastic slope $b_{ij}(s) = \frac{1}{2}(A_i^2\beta_i^2 + A_j^2\beta_j^2)\, \sigma_{tot}^{ij}(s)/\sigma_{tot}^{ij}(\infty)$. This formula agrees with the experimental slope for p-p, $\bar{p}$-p, K^+-p, K^--p and $\pi^{\pm}$-p elastic scattering from 3 to 1500 GeV/c, with only 3 parameters: $A_\pi^2 = 6.1$, $A_K^2 = 3.3$ and $A_p^2 = 10.5$ $(GeV/c)^{-2}$. (auth)

1177 IMPACT PICTURE OF pp, $\bar{p}$p, $\pi^{\pm}$p, AND $K^{\pm}$p ELASTIC SCATTERING FROM 20 TO 5000 GeV. Cheng, H. (Massachusetts Inst. of Tech., Cambridge); Walker, J. K.; Wu, T. T. Contract AT(49-8)-3000. Phys. Lett.; 44B: No. 1, 90-101(2 Apr 1973).

A simple model is given of hadron scattering from 20 to 5000 GeV, which is based on the impact picture derived from quantum field theory. Numerical results, consistent with existing data are given and in addition the general behavior of high energy hadron-hadron elastic scattering is predicted. (auth)

Strong (Baryon No. = 1)

1178 (COO-3533-14) SYMMETRIC GROUP AND MESON BORN AMPLITUDES. Frampton, P. H. (Syracuse Univ., N. Y. Dept. of Physics). Jan 1973. 40p. (SU-4205-14). Dep. NTIS $4.00.

Born amplitudes for a theory of nonstrange meson interactions are constructed. (JFP)

1179 (DESY-73/3) INFORMATION ON THE DYNAMICS OF THE REACTION KN → K*N FROM K_LN INTERACTIONS. Dass, G. V. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Feb 1973. 14p. Dep. NTIS (U. S. Sales Only) $3.00.

If $K^*_{S,L}$ is a K* resonance decaying into $K_{S,L}$ (the short-, long-lived kaon) and a neutral system S^0 of pions, one can isolate the C-even and C-odd, crossed channel contributions to KN → K*N by using the reactions $K_L N \to K^*_{S,L} N$ whether S^0 is a C-eigenstate, or a mixture of C-even and C-odd states. Applications to the production of K^*_{S0} and the Q-meson are discussed, and simple numerical predictions made for $Q_{S,L}$ production. Q-production data indicate approximate t-channel helicity conservation for the ω and P′ exchanges at vertices involving a spin change, in similarity to the belief for the Pomeron. $Q_{S,L}$ production data can give information also on Q-decays. (auth)

1180 (JINR-P2-6950) CORRELATIONS BETWEEN THE NEUTRAL AND CHARGED PIONS IN π⁻p- AND π⁻n-INTERACTIONS AT p = 40 GeV/c. Grishin, V. G.; Kuleshov, S. P.; Matveev, V. A.; Sissayan, A. N.; Yancho, G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The multiparticle production model for high energy processes suggested previously is developed for investigation of the correlation between the average number of π^0-mesons $\langle n_{\pi^0}\rangle_{n_c}$ and the number of charged particles n_c. The linear dependence $\langle n_{\pi^0}\rangle_{n_c}$ upon n_c is predicted for high energy π⁻p- and π⁻n-interactions. Comparison of the model with experimental data on π⁻p- and π⁻n-collisions at pc = 40 GeV gives good agreement. The model provides a simple physical interpretation of the dependence $\langle n_{\pi^0}\rangle_{n_c} = \frac{1}{2} n_c$, which could be expected at "extremely" high energies. (auth)

1181 WILSON METHOD IN THE STATIC NUCLEON MODEL. Belavin, A. A.; Yurishchev, M. A. (Gorky State Univ., USSR). Zh. Eksp. Teor. Fiz.; 64: No. 2, 407-412(Feb 1973). (In Russian).

An expansion in powers of $\epsilon = 2 - d$ (d is space dimension) is determined in the static model for the index η (nucleon Green function index) with an accuracy to terms of ϵ^4. The expansion completely agrees with the true value of η which can be derived from the exact solution for the model. (auth)

1182 APPLICATIONS OF MUELLER THEORY TO TWO-PARTICLE INCLUSIVE PROCESSES. Brower, R. C. (California Inst. of Tech., Pasadena); Ellis, J.; Cahn, R. N. Phys. Lett.; 44B: No. 1, 81-84(2 Apr 1973).

Assuming factorization, and extracting inclusive Reggeon vertices from one-particle inclusive data, Regge corrections to scaling are predicted for several two-particle inclusive processes. The data on p + p → π⁻ + π⁻ + X, K⁺ + p → π⁻ + π⁻ + X, K⁻ + p → π⁺ + π⁻ + X, and π⁺ + p → π⁻ + π⁻ + X agree with the predictions. (auth)

1183 AMPLITUDE ANALYSIS OF πN CHARGE EXCHANGE AT LARGE MOMENTUM TRANSFER. Elvekjaer, F.; Inami, T.; Ringland, G. (Rutherford High Energy Lab., Chilton, Eng.). Phys. Lett.; 44B: No. 1, 91-96(2 Apr 1973).

Evidence is found for the right-signature zero at $t \approx -1.5$ $(GeV/c)^2$ and the second wrong-signature zero at $t \approx -2.5$ $(GeV/c)^2$ in the helicity flip ρ-Regge-pole exchange from an amplitude analysis of πN charge exchange extended to large momentum transfer. Reconstruction of the imaginary part of the nonflip amplitude suggests a remarkable degree of Regge behavior out to large −t. Confirmation of such behavior would undermine the basic features of absorptive cut models. (auth)

1184 STUDY OF THE PION-POMERANCHON REGGE CUT USING GRIBOV'S APPROACH TO THE MANDELSTAM DIAGRAM. Chia, S. P. Urbana, IL; Univ. of Illinois (1972). 144p. University Microfilms Order No. 73-9905.

Thesis (Ph. D.).

A model is developed in which the pion-Pomeranchon Regge cut is calculated from the Mandelstam diagram. Explicit calculations are made for three π-exchange process: np → pn, π⁻p → ρ⁰n and π⁺p → ρ⁰Δ⁺⁺. In the model, the Pomeranchon exchange is assumed to be mediated by an isoscalar scalar σ-meson. Convergence of loop integrals is ensured by inserting form factors to relate the off-shell pion exchange amplitudes to known on-shell behavior. Parameters in the model are the mass and coupling constants of the σ-meson, and the cut-off masses in the cut-off form factors. The model compares well with the data over a fairly wide range of energy. In particular, the model extrapolates well to t = −1.0 GeV^2 although the parameters are obtained from a fit to much smaller values of t ($|t| < 0.1$ GeV^2). Several general properties of the cut can be deduced from the results. The cut is self-conspiratory. Amplitudes with unnatural parity and unnatural charge conjugation parity in the t-channel receive no contributions from the cut. Furthermore, the contributions from the cut to amplitudes with natural parity in the t-channel are strong only if the amplitudes have double helicity flip in the s-channel. (Diss. Abstr. Int., B)

1185 COMPARISON OF VARIOUS $\bar{K}N$ PARTIAL WAVE ANALYSES IN THE REGION 0 TO 1400 MeV/c. Gupta, M. L.; Arndt, R. A.; Roper, L. D. (Virginia Polytechnic Inst., Blacksburg). Fortschr. Phys.; 20: No. 6, 333-364(1972).

A comprehensive comparative study of the available $\bar{K}N$ partial wave analyses is made with a view to bring out their similarities and disagreements and to point towards those momentum regions that require particular attention in all future analyses. The multichannel nature of the $\bar{K}N$ scattering is discussed along with the presently available scattering cross section data for various channels. The parametrization of the various partial wave analyses is discussed and their amplitudes calculated and compared under the set of conventions proposed by Levi Setti. (auth)

Strong (Baryon No. ≥ 2)

Refer also to abstract 1288.

1186 NUCLEON–NUCLEON INTERACTION FROM PION–NUCLEON PHASE SHIFT ANALYSIS. NN Peripheral Partial Waves. Vinh Mau, R.; Richard, J. M.; Loiseau, B.; Lacombe, M.; Cottingham, W. N. (Institut de Physique Nucleaire, Paris). At(11-1)-3001. Phys. Lett; 44B: No. 1, 1-4(2 Apr 1973).

The low energy peripheral nucleon–nucleon partial wave phase parameters are calculated from our present knowledge of pion–pion and pion–nucleon phase shifts. The results are compared with phenomenological energy independent and energy dependent phase shift analyses. (auth)

1187 I. MULTIPERIPHERAL THEORY OF MASSIVE LEPTON PAIR PRODUCTION. II. Corrections to the Equivalent Photon Approximation for Two-Photon Processes. Subbarao, K. Princeton, NJ; Princeton Univ. (1972). 111p. University Microfilms Order No. 73-9651.

Thesis (Ph. D.).

Two separate problems are investigated. (i) A multiperipheral model for the massive lepton pair production in proton collisions is developed. As a prelude, the well-known Laplace transform over the group SO(1,3) is used for repeatedly diagonalizing certain absorptive part equations, which is applied to rederive, as an illustration, the Amati-Fubini-Stanghellini expression for the cross-section to produce a given number of pions as a function of incident energy, thus exhibiting in a clear way the various approximations made. The Amati-Bertocchi-Fubini-Stanghellini-Tonin (ABFST) multiperipheral model is used to show that $(d\sigma/dQ^2) = (1/Q^4)$ $f(s/Q^2)$ where Q is the invariant mass of the produced lepton pair, $\sqrt{s}$ is the total energy of the colliding protons in the center of mass frame and it is assumed that $Q^2 \gg M^2$, M being the nucleon mass. The function f is expressed in terms of πN and NN forward absorptive amplitudes. For $s \gg Q^2$, the function $f(s/Q^2)$ behaves like al n s/Q^2 + b. It is then argued that the ABFST model can be expected to be much more reliable for the case of massive lepton pair production than when the final state has only hadrons; the generality of the model especially for $s \gg Q^2$ is elucidated. Gauge invariance of the model is discussed. (ii) The inadequacy of the well-known Weizsacker-Williams or equivalent photon approximation to two-photon processes in colliding beams is ameliorated by evaluating the leading correction term for an arbitrary final state. These terms clearly reflect the correction due to each approximation made in getting the leading term. Great care is needed in handling the smallness of the electron mass. It is pointed out that in many cases of interest, one can go a step further to get the succeeding term in the approximation. Some applications, specially in the study of spin dependence in inclusive processes, are pointed out. (Diss. Abstr. Int., B)

1188 EARLY ONSET OF SEMI-INCLUSIVE SCALING IN PROTON–PROTON COLLISIONS. Fialkowski, K.; Miettinen, H. I. (Rutherford High Energy Lab., Chilton, Eng.). Phys. Lett.; 43B: No. 6, 493-496(19 Mar 1973).

The present experimental evidence for the scaling of multiplicity distributions predicted by Koba, Nielsen and Olesen is examined critically. The results indicate that the approximate scaling observed experimentally is not necessarily connected with an "early" approach to the asymptotic limit. Some simple models are shown to predict an extremely slow approach to scaling. The possibility of distinguishing between "early" scaling and the "quasi-scaling" exhibited by these models with experiments at ISR is discussed. (auth)

1189 MULTIPLICITY CORRELATIONS BETWEEN NEUTRAL AND CHARGED PIONS FROM CHARGED MULTIPLICITY DISTRIBUTIONS. Drijard, D.; Pokorski, S. (CERN, Geneva). Phys. Lett.; 43B: No. 6, 509-513(19 Mar 1973).

It is shown that for several simple possibilities of distributing charge between pions (the so-called π, ϵ and ρ models) the ($\pi^0\pi^{ch}$) multiplicity correlations can be expressed directly in terms of the charged multiplicity distributions. Each of the models can then be tested experimentally, irrespectively of the unknown total multiplicity distribution. (auth)

1190 CORRELATION BETWEEN THE BREAK IN $d\sigma/dt$ AND THE GROWTH OF σ_{tot} in pp COLLISIONS. Leader, E.; Maor, U. (Westfield Coll., London). Phys. Lett.; 43B: No. 6, 505-508(19 Mar 1973).

It is shown that the growth of the p-p total cross section at ISR energies is intimately correlated with the break found in the logarithmic slope of the elastic $d\sigma/dt$. (auth)

1191 SPIN EFFECTS IN PROTON–PROTON CROSS SECTION MEASUREMENTS. Soffer, J. (CNRS, Marseille); Wray, D. Phys. Lett.; 43B: No. 6, 514-516(19 Mar 1973).

Bounds are obtained from positivity on the possible size of spin dependent effects on the proton–proton total cross section. (auth)

1192 TWO-PARTICLE CORRELATIONS AT ISR ENERGIES WITH DIFFRACTION AND PIONIZATION. Pirila, P.; Pokorski, S. (CERN, Geneva). Phys. Lett.; 43B: No. 6, 502-504(19 Mar 1973).

Experimental two-particle correlations at $\sqrt{s} = 31$ GeV are compared with predictions of the two-component model. An agreement is found with the predicted dominance of the long range correlations. (auth)

Particle Invariance Principles and Symmetries

General

1193 COVARIANT FORMALISM FOR THE EQUAL-TIME COMMUTATORS. Shirokov, Yu. M. (Mathematics Inst., Moscow). Teor. Mat. Fiz.; 15: No. 1, 20-42(Apr 1973). (In Russian).

The explicitly covariant formalism is developed for the general form of the equal-time commutators containing an arbitrary finite number of the Schwinger terms. In this formalism one can write out relativistically invariant systems of the equal-time commutators in the framework of the ordinary operations with 4-tensor indices. The specific covariant properties are established for the equal-time commutators containing conserved currents. The examples of the covariantization of the equal-time commutators are presented, which are of interest not only methodically but also in themselves. (auth)

1194 GROUP EXTENSIONS CONNECTED WITH THE POINCARE GROUP. Zinov'ev, Yu. M. (Mathematics Inst., Moscow). Teor. Mat. Fiz.; 15: No. 1, 139-141(Apr 1973). (In Russian).

The uniqueness of the extension of the groups by the Poincaré group is proved. The mistake in the Michel paper (Nuc. Phys., 57, 356, 1964) on the central extensions of the Poincaré group is pointed out. (auth)

1195 PROJECTION OPERATORS FOR THE SIMPLE LIE GROUPS. II. General Scheme of Constructing Lowering Operators. The Case of the Groups SU(n). Asherova, R. M.; Smirnov, Yu. F.; Tolstoi, V. N. (Moscow State Univ.). Teor. Mat. Fiz.; 15: No. 1, 107-119(Apr 1973). (In Russian).

Solution of many problems in the theory of nuclei can be reduced to the problem of projecting the wave functions ψ, which are not the eigen-functions of the integral of motion Λ, on the space of the eigen-functions of these operators Λ. To perform such projecting one needs to know the projection operators for the groups SU(n), SO(n) and other simple Lie groups. For the arbitrary simple Lie group G(l) of the rank l the general scheme is proposed of constructing the lowering and raising operators F_+, F_-, which form the complete projection operators for a given group together with the operators $P^{[f]}$ found earlier. We deal with the basis systems of irreducible representations of G(l), which correspond to restriction to the chain of the regularly embedded subgroups: $G(l) \supset G(q) \supset G(s) \supset \ldots \supset G(t)$. As an example of the concrete realization of the scheme proposed the lowering operators F_- are obtained for the canonical Gelfand–Tseitlin basis for the group U(n). The matrix elements of the generators of the group U(n) in this basis are calculated. (auth)

Applications (Electromagnetic and Weak)

1196 (COO-3533-16) PHENOMENOLOGICAL DYNAMICS FOR CP VIOLATIONS. Singer, M.; Schechter, J. (Syracuse Univ., N. Y. Dept. of Physics). Feb 1973. 27p. (SU-4205-16). Dep. NTIS $3.50.

A fairly general current-current form for the CP violating interaction is investigated in the phenomenological Lagrangian framework. Special attention is given to the computation of both the CP conserving and CP violating self masses in the K_L–K_S system. In addition the relevant amplitudes appearing in the neutral kaon decay matrix are calculated. It is found that several kinds of models naturally give the same results as the superweak theory, within present experimental accuracy. (auth)

1197 CP, T, AND CPT INVARIANCE IN NEUTRAL KAON DECAYS. Dass, G. V. (CERN, Geneva). Fortschr. Phys.; 20: No. 2, 77-104(1972).

A brief survey of the phenomenology (with emphasis on its present status) of CP, T and CPT invariance in neutral kaon decays is given. Existing limits on the invariances of the mass matrix of the $K^0 - \bar{K}^0$ system are stated. Also included are new results and also those of Dass and Kabir for limits on these invariances for the decay amplitudes, obtained by using existing data, and the available information on the total mass matrix. (LBS)

Applications (Strong)

1198 RENORMALIZATION OF THE SU(3) × SU(3) σ-MODEL FOR $O^{\pm}$-MESONS WITH LINEAR BREAKING. Khelashvili, A. A.; Khmaladze, V. Yu. (Tbilisi State Univ., USSR). Teor. Mat. Fiz.; 15: No. 1, 78-90(Apr 1973). (In Russian).

The Ward identities for the divergent Green functions are obtained in the framework of the SU(3) σ-model for $O^{\pm}$-mesons with linear breaking. The renormalization of the model is performed. The diagram technique for the renormalized perturbation series is formulated and the propagators and vertex functions are constructed in the ladder approximation. The equations for the tadpole contributions are also obtained and the investigation of the stability conditions is carried out. The validity of the Goldstone theorem in the one-loop approximation is established. (auth)

Scattering Theory

1199 NEW CLASS OF THE QUANTUM MARKOVIAN PROCESSES AND PARTIAL WAVE EXPANSION OF TRANSITION AMPLITUDE. Flohrer, J.; Garczynski, W. (Univ., Wroclaw). Acta Phys. Pol., B; B4: No. 2, 267-273(1973).

A new infinite family of the quantum Markovian processes of diffusional type is found. These processes appear naturally when passing from the Cartesian coordinate system to the polar one in the path integral. They permit one to write closed formulas for partial transition amplitudes and for various physical characteristics of the central potential scattering. (auth)

1200 CONNECTION BETWEEN PARTICLES AND POLE OF THE S-MATRIX. Fonda, L. (Univ., Trieste, Italy). Fortschr. Phys.; 20: No. 2, 135-144(1972).

In axiomatic S-matrix theory it is usually assumed that stable particles give rise to simple poles of the S-matrix for real negative energies while unstable particles give rise to poles close to the real axis on an unphysical sheet of the energy Riemann surface. The stable particle-pole association has been known for a long time not to be always true. For example in potential scattering what is relevant in this case in fact is not the S-matrix but the Jost function. The zeroes of this function for real negative energies are in fact in one-to-one correspondence with the bound states, while the correspondence may break down for the poles of the S-matrix. On the other hand it has recently been pointed out that there also is in general no connection between unstable particles and poles of the S-matrix. A short analysis is made of the two cases. (auth)

1201 RULES FOR MULTI-REGGE AMPLITUDES AND THEIR DISCONTINUITIES. Weis, J. H. (Univ. of Washington, Seattle). Phys. Lett.; 43B: No. 6, 487-492(19 Mar 1973).

It is argued that an arbitrary discontinuity of an arbitrary multi-Regge amplitude factorizes just as does the full amplitude itself. A set of rules is given for writing down the behavior of the full amplitude or any discontinuity as a product of Regge propagators, single-, double-, and triple-Regge vertices and their discontinuities. This result has numerous applications; e.g., in the consistency of the multiperipheral model and the Mueller analysis of inclusive cross sections. (auth)

PHYSICS (LOW-TEMPERATURE)

Superfluidity

1202 LOW-MOMENTUM-TRANSFER NEUTRON SCATTERING IN LIQUID HELIUM. Woods, A.D.B.; Svensson, E. C.; Martel, P. (Atomic Energy of Canada Ltd., Chalk River, Ont.). pp 359-363 of Neutron Inelastic Scattering, 1972. Vienna; International Atomic Energy Agency (1972).

From fifth IAEA symposium on neutron inelastic scattering; Grenoble, France (6 Mar 1972). See STI/PUB-308; CONF-720304-.

The energy distributions of neutrons scattered from superfluid liquid helium at wave-vector transfers $Q \leq 3.5\text{Å}^{-1}$ can be divided into two parts: a sharp peak corresponding to the excitation of a single phonon and a broader peak at higher energies. The normal interpretation of these broader peaks is that they arise from simple multiphonon scattering. However, recent Raman-scattering measurements ($Q \approx 0$) of Greytak and co-workers, which suggest the existence of a two-roton bound state in liquid helium, support recent speculation that the neutron scattering may be entirely described in terms of single-phonon excitations and a two-roton bound state. New neutron-scattering measurements at 1.2°K in the region $Q \leq 0.8\text{Å}^{-1}$ are presented. In this region the one-phonon and "multiphonon" peaks are sufficiently well separated to allow a detailed investigation of each under conditions of high experimental resolution. In the experiment, (111) planes of Ge and (002) planes of pyrolitic graphite were used as monochromator and analyzer respectively, and the scattered neutron energy was held constant at 1.193 THz (57.26°K). Filters of pyrolitic graphite and beryllium were used in the incident and scattered beams respectively. At $Q = 0.8\text{Å}^{-1}$ the higher-energy peak exhibits a long tail extending to ≈70°K. This is considerably higher than had previously been suspected. The intensity in the high-energy tail decreases rapidly as Q is decreased. At $Q = 0.3\text{Å}^{-1}$, the lowest value studied, the width of the higher-energy peak is only twice the resolution width, and its mean energy is 18.9 ± 0.6°K; this is significantly greater than twice the energy at the roton minimum. The neutron scattering measurements thus give no evidence for the existence of a two-roton bound state in liquid helium at $Q \geq 0.3\text{Å}^{-1}$, and are consistent with the earlier interpretation that the higher-energy peaks arise from simple multiphonon scattering processes. Two-phonon processes appear to dominate the scattering in the region studied, although at $Q = 0.8\text{Å}^{-1}$ the high-energy tail suggests that even higher-order processes are important. The energies of the one-phonon peaks are in good agreement with the values obtained previously. (auth)

1203 SYNTHESIS AND SUPERCONDUCTING PROPERTIES OF CUBIC RHENIUM MONOCARBIDE. Popova, S. V.; Fomicheva, L. N.; Khvostantsev, L. G. (Inst. of High Pressure, Moscow). JETP Lett. (USSR) (Engl. Transl.); 16: No. 11, 429-430(5 Dec 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 16: No. 11, 609-610(5 Dec 1972).

It is shown that a new rhenium monocarbide modification with a structure of the NaCl type is produced at pressures above 144 k bar. The superconducting properties of cubic rhenium carbide were measured by the magnetic method. The critical temperature of the transition to the superconducting state is $T_c = 3.4 \pm 0.2$°K. The obtained data confirm the previously predicted tendency of the critical temperatures of cubic monocarbides of transition metals of group VII to be lower than the isostructural carbides of the group VI metals. (MHR)

1204 NEUTRON SCATTERING BY LIQUID HELIUM UNDER PRESSURE. Woods, A.D.B.; Svensson, E. C.; Martel, P. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Phys. Lett., 43A: No. 3, 223-224(12 Mar 1973).

The neutron scattering by superfluid liquid helium at 1.2K under pressures of 0.7 and 24 atm shows that the one-phonon and multiphonon components of the scattering are markedly different at the two pressures. (auth)

1205 SUPERFLUID DENSITY NEAR THE SUPERFLUID TRANSITION POINT IN ^{3}He–^{4}He MIXTURES. Terui, G.; Ikushima, A. (Tokyo Univ.). Phys. Lett.; 43A: No. 3, 255-256 (12 Mar 1973).

The superfluid density was deduced from the second sound velocity in ^{3}He–^{4}He mixtures of low ^{3}He concentrations where the superfluid transition temperature depends almost linearly on the concentration. (auth)

1206 STUDY OF ACOUSTIC PUMPING USED TO ACHIEVE THE ANALOGOUS AC JOSEPHSON EFFECT IN He II. Andrews, E. C. University Park, PA; Pennsylvania State Univ. (1972). 83p. University Microfilms Order No. 73-7406.

Thesis (ph. D.).

In past experimental studies of the analogous ac Josephson effect in He II, a transducer has been used to initiate a flow of He II through an orifice separating two volumes of He II. An experimental study of this acoustically initiated flow, referred to as the pumping effect, was conducted in an effort to delineate the role of the transducer in the analogous ac Josephson effect in He II. The experimental results may be grouped as follows: a temperature dependence, nearly the same as that of ρ_s/ρ, for the minimum transducer power necessary to initiate pumping; an importance concerning the apparatus geometry adjacent to the orifice; a lack of importance concerning the asymmetry of the pinhole; a dependence of the pumping speed on the transducer power. In addition to the experimental results, a simplified theory was developed predicting nonzero dc helium flow upon satisfaction of the Josephson frequency condition by the meniscus level difference. This theory, when used with the model of pumping presented, is sufficient to explain the bulk of experimental data obtained by other experimenters; the usual assumption that a state of zero flow is a preferred state was discarded. Quantized vortices, while not precluded by the theory, are not a part of the development. The transducer not only initiates pumping, but also provides an ac perturbation of the chemical potential through acoustic insonification of the medium. (Diss. Abstr. Int., B)

1207 HYDRODYNAMIC MODEL FOR THE SUPERFLUID HELIUM CRITICAL VELOCITY IN ROUGH CHANNELS. Weaver, J. C. (Massachusetts Inst. of Tech., Cambridge). Phys. Lett., A; 43A: No. 5, 397-398(9 Apr 1973).

A simple model for a Feynman type critical velocity is presented which explicitly involves surface roughness as well as channel size, and can be fitted to most low temperature critical velocities in small, rough channels. (auth)

1208 THEORY OF INTERACTION OF IMPURITIES WITH SUPERFLUID HELIUM. Galas, D. J. Davis, CA; Univ. of California (1972). 227p. University Microfilms Order No. 73-8325.

Thesis (Ph. D.).

The interaction of a foreign particle with a boson superfluid is investigated from a microscopic point of view. A simple, self-consistent model for the Bose fluid was constructed and studied using both analytic methods and numerical computations. This model was then used to construct a self-consistent theory of the interacting system in an intermediate coupling approximation similar to the Lee-Low-Pines approximation for polarons. Further simplifying assumptions then permitted the subjection of the theory to some simple numerical calculations. The principal result of these calculations was the conclusion that the nonlinear interaction of the impurity with the fluid permits a reduction in the critical velocity of the impurity with respect to the simple Landau critical velocity. These calculations were done using a pseudo-potential which yields an excitation spectrum similar to the experimental spectrum when applied to the uniform fluid. A critical velocity mechanism is suggested which may be applicable to an understanding of the creation of quantized vortex rings in He-II. Study of the fluid model revealed that although the model is asymptotic to the Bogolyubov model for weak interactions, there exists a solution to the equations (at one particular value of the interaction strength) for which the boson fluid is not a superfluid: that is, it cannot support persistent currents. Beyond this point in interaction strength a reordering of the condensate (in line with previous suggestions by Girardeau and others concerning a generalized condensate) is suggested to explain the peculiar behavior of the structure factor. The final chapter is devoted to a discussion of the analogy between the superfluid velocity and the magnetic vector potential as it affects an impurity immersed in the superfluid. Following the main text of the dissertation are a number of appendices which are intended to support the analysis of the main text or discuss at greater length a relevant topic. (Diss. Abstr. Int., B)

1209 LONG-RANGE CORRELATIONS AND THE LOW TEMPERATURE PROPERTIES OF SUPERFLUID HELIUM. Zwanziger, J. Ithaca, NY; Cornell Univ. (1972). 103p. University Microfilms Order No. 73-9375.

Thesis (Ph. D.).

A variational calculation is made for the ground state energy of superfluid ^{4}He, using a Monte Carlo Method. The trial function is a Jastrow-type wave function which is a product of a short-range part of the form used by McMillan, $\exp(-(b\sigma/r)^m)$, and a long-range part suggested by Chester and Reatto, arising from phonon zero-point motion. The resulting ground state energy,

−6.08°K, and the equilibrium density, 2.07575×10^{22} particles cm^{-3}, are quite close to the experimental results −7.14°K and 2.185×10^{22} particles cm^{-3}. The correlation function and the single particle density matrix are also calculated. A model density matrix is then used to calculate the correlation function and single particle density matrix at 1.0 and 1.8°K. The condensate fraction, the asymptotic limit of the single particle density matrix, is .115, .115, .105 ± .01 at 0, 1.0, 1.8°K respectively, consistent with previous calculations. The explicit inclusion of phonon modes results in a lowering of the ground state energy and a raising of the equilibrium density. (Diss. Abstr. Int., B)

Superconductivity

Refer also to abstracts 849 and 858.

1210 (CALT−822-50) SUPERCONDUCTIVITY OF COPPER CONTAINING SMALL AMOUNTS OF NIOBIUM. Tsuei, C. C.; Newkirk, L. R. (California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials). Jan 1973. Contract AT(04-3)-822. 28p. Dep. NTIS $3.50.

Superconductivity of copper containing small amounts of niobium was investigated by measuring the electrical resistivity, superconducting volume fraction and by metallographic studies. Small amounts of niobium added to copper has a drastic effect on the low temperature resistivity of the alloys. The annealed alloy $Cu_{99.5}Nb_{0.5}$ shows zero resistance at a current density of 200 A/cm^2 below 3°K. The estimated superconducting volume fraction of this alloy at 2°K is about 50 times the physical volume fraction of the Nb in the alloy. When more Nb is added these effects unexpectedly become much smaller than those observed in the dilute alloys (<1.5 at. % Nb). Metallographic results indicate that in all the Cu−Nb alloys studied there are two distinct types of Nb particles in the Cu matrix. The large particles (average size ~10 μm) randomly distributed in the alloy are probably formed at high temperature when the bulk of the alloy is still in the liquid state. The small Nb particles (size ≳1 μm, interparticle distances <0.2 μm) probably form through a solid state precipitation. It has been found that the large precipitates are more abundant in the alloy containing more than 1.5 at. % Nb, than in alloys containing less than 1.5 at. % Nb. The observed superconducting properties of alloys $Cu_{99.8}Nb_{0.2}$ and $Cu_{99.5}Nb_{0.5}$ have been attributed to the proximity effect of the small Nb particles whose interparticle distances are compatible with the coherence length in the Cu matrix. The very wide superconducting transition shown in both the resistivity and the inductance measurements suggests a distribution in the Nb particle sizes as well as the interparticle distances. (auth)

1211 (CALT-822-51) DUCTILE SUPERCONDUCTING COPPER BASE ALLOYS. Tsuei, C. C. (California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials). Feb 1973. Contract AT(04-3)-822. 12p. Dep. NTIS $3.00.

A new class of ductile superconductors has been prepared by casting and appropriate heat treatments. These alloys superconduct between 4 and 18°K and contain at least 90 at.% copper and a superconducting phase such as Nb_3Sn or Nb. They can be processed into wires by conventional metallurgical techniques. (auth)

1212 (LA-UR-73-295) DIRECT OBSERVATION OF MAGNETIC ORDER IN "FERROMAGNETIC SUPERCONDUCTORS" BY MEANS OF THE ^{57}Fe MOESSBAUER EFFECT. Erickson, D. J.; Olsen, C. E.; Taylor, R. D. (Los Alamos Scientific Lab., N. Mex.). 1972. 16p. (CONF-730117-1). Dep. NTIS.

From 8th Mossbauer symposium; New York, New York, USA (28 Jan 1973).

For certain concentrations of R = Gd, Tb, Dy and Ho, the development of magnetic spin order in $Ce_{1-x}R_xRu_2$ at temperatures well below T_c was directly demonstrated by the appearance of magnetic hyperfine splitting in the ^{57}Fe ME spectra. Other techniques show that bulk superconductivity is also present in the materials at these low temperatures and is not degraded by the presence of magnetic order. These experimental data are therefore consistent with the $Ce_{1-x}R_xRu_2$ systems being homogeneous ferromagnetic superconductors in certain coexistence regions of temperature and rare earth concentrations. The dependence of $\theta_c(x)$ as determined by the ME measurements is shown to be in agreement with susceptibility data in the ferromagnetic region. The ME measurements also confirm the extrapolation of the susceptibility results below T_c in the region of coexistence. The $Ce_{0.96}Gd_{0.04}Ru_2$ sample showed no effects of spin order at temperatures as low as 0.5 K which supports the hypothesis that $\theta_c \to 0$ at some finite rare earth concentration. Such behavior indicates that the interaction between rare earth atoms is basically short range. A lattice consisting of interpenetrating magnetic and superconducting sublattices is an attractive picture for a ferromagnetic superconductor, even though it is not possible to state that coexistence exists down to the smallest volume element. For the (Ce, R)Ru_2 systems discussed here, it has been suggested that the superconductivity is associated with d-electrons located on the Ru sublattice. In such a picture, magnetic order would be carried on the diamond sublattice on which the magnetic rare earth atoms substitute. Coexistence is then allowed by assuming that the f-electron wave functions of the rare earths are well localized and do not appreciably overlap with the d-states of the Ru. (MHR)

1213 INFLUENCE OF HIGH-FREQUENCY FIELD ON THE TUNNEL EFFECT. Genkin, V. M. (Scientific-Research Radiophysics Inst., Gorky, USSR). JETP Lett. (USSR) (Engl. Transl.); 17: No. 1, 25-26(5 Jan 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 1, 35-37(5 Jan 1973).

It is assumed that a superconducting film of thickness $d \gg \xi_0$, λ (ξ_0 and λ are the coherence length and the field penetration depth, respectively) forms a tunnel junction with some superconductors, and that an alternating magnetic field $H_0 \cos \omega$ is applied to the external surface of the film. At small ω the field does not penetrate into the junction under such conditions, and the film superconductivity parameter Δ is equal to its equilibrium value Δ_0 in the region of the junction. If $\omega = \Delta_0$, the situation may be somewhat different. It has been shown previously that the superconductivity parameter of a bulky Type-I superconductor is changed by the action of the alternating field of frequency Δ_0 up to distances on the order of the mean free path l from the surface. It is assumed that in the absence of the field the superconductivity parameter has the same value near the surface as in the interior of the superconductor. Therefore, if the thickness $d \sim l \gg \xi_0$ and $\omega = \Delta_0$, then the tunnel current is modulated at a frequency $2\Delta_0$, even though the alternating field does not penetrate directly into the junction. This is the effect considered here. (MHR)

1214 SCREENING THEORY OF THE SPECIFIC HEAT TRANSITION IN DIRTY BULK SUPERCONDUCTORS IN A MAGNETIC FIELD. Bray, A. J. (Univ. of Kent, Canterbury, Eng.). Phys. Lett.; 43A: No. 3, 277-278(12 Mar 1973).

The specific heat of a dirty bulk superconductor in a magnetic field was calculated using a screening treatment of the order parameter fluctuations. The results agree qualitatively with the measurements of Barnes and Hake. The transition width scales as $H^{\frac{4}{3}}$. (auth)

1215 OBSERVATION OF AN OSCILLATING BEHAVIOR IN A SUPERCONDUCTING TRANSITION. Olsen, C. E. (Los Alamos Scientific Lab., NM). Phys. Lett.; 43A: No. 3, 205-206(12 Mar 1973).

An oscillating behavior of superconducting transitions in a thorium disilicide-one at.% americium alloy was observed. (auth)

1216 FLUXOID QUANTIZATION AND PHASE TRANSITION IN HOLLOW SUPERCONDUCTORS CARRYING TRANSPORT CURRENT. Rabinowitz, M.; Garwin, E. L. (Stanford Univ., CA). Lett. Nuovo Cim.; 6: No. 9, 329-335(3 Mar 1973).

In the observations of periodicity in the transition temperature in units of the quantum h/2e, a quadratic background has been observed upon which the periodicity lies. Here a theory is developed to explain the apparently disparate sets of results on this subject of Tinkham [Phys. Rev. 129, 1413(1963)] and Parks and Little [Phys. Rev., 133 A 97(1964)]. (MHR)

1217 HIGH-TEMPERATURE SUPERCONDUCTIVITY IN THREE-DIMENSIONAL SYSTEMS. Geilikman, B. T. (Inst. of Atomic Energy, Moscow). Usp. Fiz. Nauk; 109: No. 1, 65-90 (Jan 1973). (In Russian).

This review of contemporary developments in the area of high-temperature superconductivity offers an extensive introduction to the subject, beginning with W. A. Little's treatment (1964) of the superconductivity of a polymer molecule and a special model consisting of a central polymeric chain with side chains. Systems with collectivized electrons of one group and localized electrons of another group are considered extensively in theory. These generalizations are applicable to compounds of metals with nonmetals, dielectrics, organic substances, unalloyed semiconductors, and molecular crystals, and experimental investigations of superconducting materials of these types are cited. Special theoretical discussion is devoted to systems with two (or more) groups of collectivized electrons, such as pure metals of the transition group. 86 references. (KSW)

1218 DYNAMIC INTERMEDIATE STATE UNDER THE INFLUENCE OF A HEAT CURRENT. Laeng, P.; Rinderer, L. (Univ., Lausanne, Switzerland). Helv. Phys. Acta; 46: 8-12(1972).

Direct observation of a dynamic intermediate state is reported in lead under the influence of a heat current. Transverse as well as parallel motions were observed. Preliminary results are discussed and compared with the existing theory. (auth)

1219 ENERGY CURRENTS IN SUPERCONDUCTORS. Cohen, G. S. *(Kent Univ., Canterbury, Eng.), J. Phys., F (London); 3:* No. 3, 585-596(Mar 1973).

Various inadequacies and inconsistencies of previous treatments *of heat flow in a nonequilibrium superconductor are pointed out.* The energy current associated with a quasistatic time-dependent order parameter is calculated near the transition temperature using standard techniques and a result obeying the equation of continuity is obtained. Further microscopic calculations indicate *the existence of local temperature gradients which drive the* entropy current. An attempt is made to calculate corresponding additional terms in the time-dependent Ginzburg–Landau equation. *(auth)*

1220 CORRECTION TO THE JOSEPHSON CURRENT IN THE *SECOND ORDER OF THE PERTURBATION THEORY WITH RE*SPECT TO TRANSPARENCY. Antsygina, T. N.; Svidzinskii, A. V. (Physical-Technical Inst. of Low Temperatures, Kharkov). Teor. *Mat. Fiz.; 14: No. 3, 412-419(Mar 1973). (In Russian).*

The correction of the second order with respect to transparency is calculated for the Josephson current in the tunnel contact connecting two identical superconductors. The dependence of the correction on the coherent difference of phases φ between the super*conductors is represented as a linear combination of sin φ and* sin 2φ. (auth)

1221 JOSEPHSON CURRENT THROUGH S/N/S JUNCTION CONTAINING PARAMAGNETIC IMPURITIES WITH LOCAL STATES WITHIN THE GAP. Kumar, P.; Gupta, S. N. (Univ. *of Roorkee, India). Phys. Lett; 43A: No. 3, 293-294(12 Mar* 1973).

The ratio of zero bias, zero temperature Josephson current *through SNS (superconductor/normal metal/superconductor)* junction containing paramagnetic impurities with local states within the gap, to that of the pure–SNS junction, is studied and found to be $1-\xi[(1/\epsilon_0^2) + (1/4\epsilon_0^4) - (1/4\epsilon_0^6)]$, where ξ is a measure of impurity concentration and ϵ_0 is the normalized position of a local *state within the gap. (auth)*

1222 INTERFACIAL ELECTRON TUNNELING OF SUPER*CONDUCTING SURFACES. Halbritter, J. (Univ., Karlsruhe,* Ger.). Phys. Lett.; 43A: No. 3, 309-310(12 Mar 1973).

Interfacial tunneling was calculated for metal oxide interfaces, *showing that in superconductors the tunneling exchange disap*pears with $T \to 0$. This temperature dependent tunneling measures the electron trap density in oxides near the metal. (auth)

1223 COMPLEX CONDUCTIVITY OF THE SURFACE SHEATH OF A TYPE-II SUPERCONDUCTOR AT ALL MAGNETIC *FIELDS. Walton, B. L.; Rosenblum, B.; Bridges, F. (Univ. of* California, Santa Cruz). Phys. Lett.; 43A: No. 3, 263-265(12 Mar 1973).

The complex microwave surface impedance of $Pb_{0.83}-In_{0.17}$ was measured and a simple model was used to derive the sheath conductivity. *The result, that even at fields considerably below H_{c2}* this conductivity is very different from that at zero field, is unexpected. (auth)

1224 PART A. RESISTIVE TRANSITION IN A NARROW SUPERCONDUCTING FILAMENT. Part B. Thermal Conductivity *of a Cubic Antiferromagnet in a Magnetic Field (Preliminary Re*port). Londergan, R. J. Pittsburgh; Carnegie–Mellon Univ. (1973). 95p. University Microfilms Order No. 73-9137.

Thesis (Ph. D.).

The contribution of thermal fluctuations to the conductivity of a narrow superconducting filament is examined. A Fokker–Planck equation based on time-dependent Ginzburg–Landau theory is used to describe the system. A variational solution of this equation yields an upper bound for the resistivity as a function of temperature in the limit of small electric field. The conductivity must be evaluated through numerical solution of the differential equation for *an anharmonic two-dimensional oscillator. The conductivity result* is accurate above T_c and appears to be a good estimate at and just below T_c as well. A preliminary investigation of the field depen*dence of the thermal conductivity of a cubic antiferromagnet at low* temperatures is presented. From the experimental results of Walker in $RbMnF_3$, magnon interference with phonon conduction is suggested. The influence of magnon phonon coupling is estimated by introducing magneto-elastic waves as the thermal carriers. The *magnon spectrum is derived in creation operator formalism, and* a procedure for calculating the magneto-elastic wave properties is developed. *The calculation of the magneto-elastic wave spectrum and contributions to the thermal conductivity await numerical com*putation. (Diss. Abstr. Int., B)

1225 FLUCTUATION EFFECTS IN THE MEAN FIELD REGION OF THE SUPERCONDUCTING TRANSITION OF AMORPHOUS BISMUTH FILMS. Silverman, P. J. College Park, MD; Univ. of Maryland (1972). 146p. University Microfilms Order *No, 73 9720,*

Thesis (Ph.D.).

Improved measurements have been made of the temperature de*pendence of the resistivity of amorphous Bi films in order to ob*serve the effects of superconducting fluctuations on the film conductance. Measurements were made in the temperature range $T_c \le T \le 2.5\ T_c$ in zero magnetic field and in parallel and perpendicular magnetic fields up to 6 kG. Temperature resolution near *T_c of 0.2 mK and precise resistance measurements at higher tem*peratures (1 part in 10^4) permitted a careful comparison with theory. The films' conductivities were in close agreement with *the predictions of Aslamazov and Larkin, and did not show an* appreciable contribution from the Maki diagram. Films over 500 Å thick showed the change from thin film (two-dimensional) behavior to bulk (three-dimensional) behavior as the temperature was raised above T_c. Measurements made in perpendicular magnetic fields were in agreement with a form of the Aslamazov–Larkin theory modified to take into account the effect of the field on the fluctuations. Parallel magnetic fields were found to broaden *the resistive transition to superconductivity; however, they did not* have a strong effect on the temperature dependence of the fluctuation conductivity. (Diss. Abstr. Int., B)

1226 MICROSCOPIC INVESTIGATIONS IN THE INTERMEDIATE STATE. Babu, S. A. College Park, MD; Univ. of Maryland *(1972), 95p, University Microfilms Order No. 73-9672.*

Thesis (Ph. D.).

A model of the intermediate state of a superconductor for low *temperatures $T \ll T_c$, consisting of alternate normal N and super*conducting S layers is investigated. The effective pairing interaction constant throughout the material, is $V_N = V_S$; the BCS potential $\Delta_S = \Delta$, $\Delta_N = 0$; the magnetic field $H_S = 0$; $H_N = H_c$, the thermodynamic critical field. The Green's function in N is obtained assum*ing the above values of Δ, H and V. The magnetic field is included* in the semiclassical approximation. The pair potential is calculated for $T \approx 0$. An electron in N, with an excitation energy less than Δ *gets completely reflected at the SN interface as a hole with little* change in momentum, but with all the three components of velocity changed in sign. To illustrate the effects of such a reflection, the transverse ultrasound attenuation of a wave with polarization along the x axis, traveling along the z axis with a wavevector q, such that $ql \gg 1$; l is the mean free path, is calculated. *The transverse elec*tric conductivity is shown to be larger, due to reflections at the SN interface, than the extreme anomalous value. The increased con*ductivity lowers the attenuation. It is possible for excitations of* energy less than Δ, in N region of width a, to be quantized due to multiple reflections from the NS interfaces, with $R_c \gg l \gg a \gg \xi$. *This has the effect of freezing out most of the Fermi sea for all but* very high frequency transport phenomena. It is predicted that the frequency at which the transverse screening breakdown occurs is lowered. (Diss. Abstr. Int., B)

1227 PARAMAGNETIC CRITICAL STATE: PINNING IN A *SERIES OF TYPE-II SUPERCONDUCTING ALLOYS. Brand, R. A.* Ithaca, NY; Cornell Univ. (1972). 168p. University Microfilms Order No. 73-9340.

Thesis (Ph. D.).

The critical state is studied in a series of high field, transition metal (TM) superconducting alloys, *specifically to investigate the* effects of normal state paramagnetism. The Ti–Nb and Ti–V alloy systems were chosen so as to provide a range of upper criti*cal fields, and paramagnetic effects. Critical current measure*ments were chosen because of the simplicity of analyzing the data. The critical force density is $F_p = J_c B/10$ dynes/cm^3. The critical *current J_c (amperes); the internal field B (Oe). (MHR)*

1228 SUPERCONDUCTIVITY IN THE PALLADIUM–SILVER–*DEUTERIUM SYSTEM. Buckel, W.; Stritzker, B. (Kernfors*chungsanlage, Juelich, Ger.). Phys. Lett.; 43A: No. 5, 403-404 (9 Apr 1973).

Superconducting transition temperatures up to 16 K were observed for Pd–Ag alloys charged with deuterium or hydrogen by ion implantation at liquid helium temperatures. *(auth)*

1229 COEXISTENCE OF SUPERCONDUCTIVITY AND MAGNETISM. Smit, W. A.; Vertogen, G. (Univ., Groningen, Nether*lands).* Phys. Lett., A; 43A: No. 5, 455-456(9 Apr 1973).

A model consisting of the BCS–Hamiltonian and Zener's s–d *exchange interaction is solved rigorously in the thermodynamic* limit. Coexistence of superconductivity and magnetism is only possible for an impurity spin concentration smaller than a half *at $T \neq 0$. (auth)*

1230 FEASIBILITY OF NONPHONON MECHANISM OF *SUPERCONDUCTIVITY IN THE ALLOY Nb_3Sn. Golovashkin,* A. I.; Motulevich, G. P. (Lebedev Inst. of Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 17: No. 2, 79-81(20 Jan 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 2. 114-116(20 Jan 1973).

The nonphonon superconductivity mechanism is considered by determining the values of the electron–phonon interaction constant and the effective Coulomb pseudopotential for Nb_3Sn. (JFP)

1231 BEHAVIOR OF $\rho_f(H)$ NEAR $H_{c2}(T)$ OF EXTREMAL TYPE-II SUPERCONDUCTORS. Goncharov, I. N.; Khukhareva, I. S. (Joint Inst. for Nuclear Research, Dubna, USSR). JETP Lett. (USSR) (Engl. Transl.); 17: No. 2, 58-60(20 Jan 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.: 17: No. 2, 85-87(20 Jan 1973).

An experimental verification is given of the strong decrease of the parameter $k_2(t)$ with decreasing temperature which should lead to a corresponding growth of $r'(t)$. The dependence of the differential resistance on the magnetic field at different temperatures in Nb–80% Zr ribbon samples is studied. (JFP)

1232 SUPRALEITUNG: GRUNDLAGEN UND ANWENDUNGEN. (Superconductivity: Basis and Applications). Buckel, W. Weinheim, Ger.; Physik Verlag (1972). 305p.

In this book, the basic concepts of superconductivity are clearly presented, doing away with mathematical formulas. With the help of these basic concepts, multiple phenomena are discussed. In a concluding chapter, the technical applications are individually treated. (GF)

Equipment and Devices

Refer also to abstracts 588, 975, 980–983, 999, 1010, and 1011.

1233 (JINR-P13-6942) SENSITIVE SUPERCONDUCTING QUANTUM MAGNETOMETER. Vasiliev, B. V.; Grebinnik, V. G.; Simkin, V. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1973. 16p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The quantum magnetometer with the sensitivity near 10^{-8} Gs/sec$^{1/2}$ is described. Josephson point contact, shunted with the superconducting inductance, serves as a detector. The magnetometer was designed at the Neutron Physics Laboratory (JINR). (auth)

1234 LOW THERMAL CONDUCTIVITY SPACING SYSTEM. Bochirol, L. (to Commissariat a l'Energie Atomique). French Patent 2,115,665. 7 Jul 1972. Filed date 27 Nov 1970. 5p. (In French).

A low thermal conductivity spacing system capable of transmitting large mechanical forces was developed for cryostat devices provided with assemblies of superconducting coils. The systems can also be used in other equipment provided with superconducting coils: magnets for plasma containment, magnets used to produce magnetic fields in bubble chambers. The system consists of a stack of small diameter balls distributed in regularly arranged mountings. Each mounting is laterally retained by a ring which completely encloses it, the depth of the rings being such as to avoid any possibility of their mutual contact. The low thermal conductivity balls, which support the compressional stresses without becoming permanently deformed, are made of metallic carbide or alloys given surface treatments. (France)

1235 50 Hz LOSS MEASUREMENTS ON SUPERCONDUCTING NIOBIUM COAXIAL CONDUCTORS. Grigsby, R.; Rogers, E. C. (British Insulated Callender's Cables Ltd., London). Cryogenics; 13: No. 2, 100-102(Feb 1973).

A method is described for the measurement of ac losses in a cylindrical conductor forming part of a coaxial superconducting pair. Results given for 25 μm niobium are substantially lower than previous values obtained for this material when tested in the form of narrow strips, and show that, if used as the conductor in a superconducting power cable, the material could carry a peripheral current density of 360 A cm^{-1} with tolerable losses (<10 μW cm^{-2}) at temperatures of up to 7 K. (auth)

1236 SUPERCONDUCTIVE TUNER WITH BROAD TUNING RANGE. Vig, J. R.; Gikow, E. (Army Electronics Command, Fort Monmouth, NJ). Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 1, 122-123(Jan 1973).

The tuner discussed is a superconductive, tunable, parallel LC resonant circuit. The inductance and capacitance are varied simultaneously. A tuning range of 17 : 1 in frequency has been achieved within a single band. Bandwidth can be controlled by coupling control. Q's in excess of 10^5 were measured. (auth)

1237 ATTAINMENT OF A LOW-NOISE HIGH-POWER AND HIGHLY STABLE GUNN OSCILLATOR BY COUPLING TO A SUPERCONDUCTING CAVITY. Jimenez, J. J.; Benard, J.; Sudraud, P.; Septier, A. (Paris Univ., Orsay, France). Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 1, 123-124(Jan 1973).

A 100-mW Gunn-diode oscillator has been coupled to a 5×10^8 Q factor superconducting Nb cavity. The frequency stability is then improved up to 1.8×10^{-11} over a measuring time of 10s. The long-term frequency shift is removed by placing the cavity in a constant pressure vessel cooled by the He bath. The FM noise has been measured at modulating frequencies as close to the carrier as 0.1 Hz. (auth)

1238 FREQUENCY CHARACTERISTICS OF SUPERCONDUCTIVE COAXIAL LINES. Chiba, N. (Nippon Telegraph and Telephone Public Corp., Tokyo); Kashiwayanagi, Y.; Mikoshiba, K. Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 1, 124-125(Jan 1973).

By precise manufacturing methods, 1.6-mm 50-Ω superconductive coaxial lines having few impedance irregularities (0.2 to 0.3 Ω) have been produced. Their attenuation constant at 4.2 K shows a smooth gradual increase up to 12.4 GHz in proportion to frequency. The loss at 1 GHz is 0.7 dB/km for the line using tetra fluoroethylene-hexa fluoropropylene (FEP) and 1.6 dB/km for the line us g polyethylene (PE). (auth)

1239 LOW-FREQUENCY APPLICATIONS OF SUPERCONDUCTING QUANTUM INTERFERENCE DEVICES. Clarke, J. (California Univ., Berkeley). Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 1, 8-19(Jan 1973).

The applications of Josephson junctions to the measurement of low-frequency magnetic fields and voltages are reviewed. The relevant ideas of flux quantization and Josephson tunneling are very briefly reviewed, and the various methods of making Josephson junctions mentioned. The two basic types of magnetic sensor, the dc superconducting quantum interference device (SQUID) and the RF SQUID, are described in some detail. Their theory of operation, noise limitations, and application to practical devices are discussed. The resolution of SQUID's commonly used in an analog mode is 10^{-4} to $10^{-3}\Phi_0/\sqrt{\text{Hz}}$, where Φ_0 is the flux quantum. The basic sensor may be used in conjunction with a flux transformer to measure magnetic fields (with a resolution of 10^{-14} T/$\sqrt{\text{Hz}}$), magnetic-field gradients (with a resolution of 10^{-12} T/m/$\sqrt{\text{Hz}}$), and magnetic susceptibilities. The SQUID may also be used as a voltmeter. The resolution is limited by the Johnson noise developed in the resistance of the low-temperature circuit, provided that this resistance is not too large: the upper limit in the liquid-He^4 temperature range appears to be a few tens of ohms. (auth)

1240 NEW TECHNIQUE FOR RF MEASUREMENTS USING SUPERCONDUCTORS. Kamper, R. A.; Simmonds, M. B.; Adair, R. T.; Hoer, C. A. (National Bureau of Standards, Boulder, CO). Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 1, 121-122(Jan 1973).

The quantization of magnetic flux in a superconducting circuit can serve for the measurement of electrical quantities in the same way that we use the wavelength of light to measure length. A demonstration of this function in the measurement of attenuation ratio at a frequency of 30 MHz is reported. (auth)

1241 MIT-EEI PROGRAM ON LARGE SUPERCONDUCTING MACHINES. Kirtley, J. L. Jr. (Massachusetts Inst. of Tech., Cambridge); Smith, J. L. Jr.; Thullen, P.; Woodson, H. H. Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 1, 112-115(Jan 1973).

A progress report on the program at MIT to demonstrate the feasibility and potentials for the application of superconductors in the rotating field windings of large central station synchronous generators is presented. A brief history of the program and a synopsis of previously reported results are given. The second experimental machine (which will have a rating of about 2 MVA) is described. (auth)

1242 DEVELOPMENT OF SUPERCONDUCTING DC MACHINES AT INTERNATIONAL RESEARCH AND DEVELOPMENT CO., LTD. Appleton, A. D. (International Research and Development Co., Ltd., Newcastle upon Tyne, Eng.). Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 1, 106-111(Jan 1973).

The entire program of the development of superconducting dc machines at International Research & Development Co., Ltd. (IRD) from 1963 onwards is covered. The early thinking on the choice of the type of machine and the reasons for selecting the homopolar are described; the first 50-hp model motor and the 3250-hp Fawley motor are then discussed. A brief account is given of the testing of the latter both at IRD and Fawley. An account is given of the approach to the development of these machines at IRD, concerning principally the areas of current collection, magnetic screening, and terminal voltage. The importance of achieving a high current density in brushes is explained and an account is given of a new method of current collection developed at IRD and is based upon the use of carbon fibers. A brief discussion is made on superconducting windings, refrigeration systems, speed control, and the effects of failure of the cryogenic plant. Finally, reference is made to the

superconducting marine propulsion system now under construction at IRD. (auth)

1243 SUPERCONDUCTING ELECTRICAL MACHINERY. Mole, C. J.; Brenner, W. C.; Haller, H. E. III (Westinghouse Electric Corp., Pittsburgh). Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 1, 95-105(Jan 1973).

Recent developments in superconductors have made possible the application of superconductivity in the windings of electric machinery. Extensive studies were made, and several experimental superconducting machines were built and tested. In synchronous machines, the higher currents and flux densities in a superconducting field winding offer savings in size, weight, and cost. In homopolar machines, the greater flux densities make possible higher terminal voltages. This, with the development of liquid-metal current collection, makes homopolar machines a feasible alternative to conventional dc machines for high-power applications. (auth)

1244 SUPERCONDUCTING ELECTRIC PROPULSION SYSTEMS FOR ADVANCED SHIP CONCEPTS. McCann, E. F. II; Mole, C. J. Nav. Eng. J.; 84: No. 6, 35-45(Dec 1972).

Application studies of superconducting electrical propulsion systems to advanced marine vehicle concepts indicate the realizability of advantages in design flexibility and weight-volume reduction. In several marine vehicle concepts, including advanced displacement vehicles and hydrodynamic and aerostatic lift-augmented configurations, systems integration has been conducted regarding vehicle concept, propulsion requirements and the constraints of concept geometry. Results indicate that the superconducting electrical propulsion system may prove to be among the only feasible and competitive methods of energy conversion compatible with the demands of the marine environment. Principal system elements are discussed in the light of developmental progress of superconducting electrical propulsion systems. (auth)

1245 LARGE-SCALE APPLICATIONS OF SUPERCONDUCTING COILS. Stekly, Z. J. J.; Thome, R. J. (Magnetic Corp. of America, Waltham, MA). Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 1, 85-95(Jan 1973).

Superconducting coils have been utilized in a broad range of applications which continues to expand. Initially, they were used for small physics experiments in the laboratory. More recent applications involve superconducting coils on a scale that would have been unrealistic only a few years ago. Some of these applications are discussed here. After a brief review of the main characteristics of superconductors and superconducting windings in general, specific applications are discussed. These include high-energy physics, controlled thermonuclear fusion, magnetohydrodynamic power generation, inductive energy storage, and levitation of high-speed ground vehicles. Photographs and illustrations are included to describe some of the existing systems as well as some systems which are presently conceptual in nature. (auth)

1246 WEAKLY SUPERCONDUCTING CIRCUITS. Notarys, H. A.; Wang, R. H.; Mercereau, J. E. (California Inst. of Tech., Pasadena). Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 1, 79-84(Jan 1973).

An equivalent circuit has been developed for the time-dependent dissipating state of superconductivity which accompanies quantum phase slip. This equivalent circuit is used here to analyze the superconducting thin-film ring magnetometer and to determine its operating characteristics in terms of measurable circuit parameters. (auth)

1247 MINIATURE SUPERCONDUCTIVE COAXIAL TRANSMISSION LINES. Nahman, N. S. (National Bureau of Standards, Boulder, CO). Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 1, 76-79(Jan 1973).

The development of miniature superconductive coaxial transmission lines is traced concisely from the original invention as a vertical channel signal delay line for fractional nanosecond pulse oscillography to present-day work towards highly compact, broadband, and low-loss telecommunication cables. The present state of development yields a 1.6-mm coaxial line operating at 4.2K and having Pb conductors, polyethylene dielectric, $Z_0 = 50 \pm 0.3\ \Omega$ and a 1-GHz attenuation of the order of 1 dB/km. The attenuation up to 1 GHz is mainly due to dielectric losses. (auth)

1248 SUPERCONDUCTING LEAD CAVITIES AT 35 GHz. Danielsen, M. (Technical Univ. of Denmark, Lyngby). Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 1, 71-76(Jan 1973).

An investigation of machined superconducting lead cavities operating in the circular cylindrical TE_{011} mode at 34.8 GHz is reported. Measured values of the surface resistance and the shift of the resonance frequency are presented and compared with calculated values. Construction criteria for high-Q cavities are proposed, based on a discussion of the different loss mechanisms in a cavity. According to these criteria 10 cavities were processed and investigated by Q measurements. The surfaces were examined by microscope. A new untraditional method for examining machined surfaces was applied. Recognizing that a surface with surface defects has both inferior electrical properties and decreased mechanical strength compared with a perfect surface, different surfaces were treated in ultrasonic baths in order to examine the mechanical strength. The degree of destruction of the surfaces was compared with the Q values of cavities with surfaces constructed in the same way. (auth)

1249 SUPERCONDUCTING RESONATORS AND DEVICES. Hartwig, W. H. (Univ. of Texas, Austin). Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 1, 58-70(Jan 1973).

The high-frequency properties of superconductors are reviewed, including the London, Pippard, and Mattis–Bardeen surface impedance, and techniques for measuring and separating losses are discussed. Residual resistance mechanisms are described and evaluated, including high field effects. The state of knowledge is shown to be adequate for engineering design. Applications of superconducting resonators and lines to filters, tuners, oscillators, amplifiers and mixers, transmission lines, antennas, optical and radiation detection, and materials research are discussed. (auth)

1250 ANALOG-COMPUTER STUDIES ON MICROWAVE MIXING IN SUPERCONDUCTING WEAK LINKS. Russer, P. H.; Bayegan, H. (Technische Hochschule, Vienna). Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 1, 46-50(Jan 1973).

The dc characteristics of superconducting weak links, irradiated by one and two microwave frequencies and the dependence of the absorbed microwave power on the dc current, are evaluated. Within the constant voltage steps, the ac current generated in the weak link is synchronous with the incident microwaves or their mixing products. In the case of two incident microwave frequencies within the constant voltage steps, the dependence of the ratio of power-absorption variation on the impressed dc current at the two frequencies is governed by modified Manley–Rowe equations. (auth)

1251 SUPERCONDUCTING INSTRUMENT SYSTEMS. Goodman, W. L.; Hesterman, V. W.; Rorden, L. H.; Gores, W. S. (Develco, Inc., Mountain View, CA). Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 1, 20-27(Jan 1973).

Some recently developed superconducting instrument systems which are based upon the use of a highly reliable thin-film superconducting quantum interference device (SQUID) are discussed in detail. These SQUID's, which are shown to have a noise temperature of less than 2×10^{-4} K, are capable of measuring: 1) magnetic flux with a sensitivity of 10^{-11} G·cm^2 rms/$\sqrt{\text{Hz}}$; 2) magnetic field with a sensitivity of 10^{-11} G rms/$\sqrt{\text{Hz}}$; 3) magnetic field gradient with a sensitivity of 10^{-11} (G/cm) rms/$\sqrt{\text{Hz}}$. Construction details and performance data are presented on systems capable of making the above measurements. (auth)

1252 FLUX SHUTTLE: A JOSEPHSON JUNCTION SHIFT REGISTER EMPLOYING SINGLE FLUX QUANTA. Fulton, T. A.; Dynes, R. C.; Anderson, P. W. (Bell Telephone Labs., Murray Hill, NJ). Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 1 28-35(Jan 1973).

A shift register is described which employs as information bits the flux quantum vortices occurring in Josephson junctions of extended dimensions. The positions of the vortices can be controlled and manipulated by an appropriately designed circuit geometry and by application of currents and magnetic fields. The time required for switching of the position of a vortex can approach the period of the Josephson plasma oscillation (~10 ps) and the intrinsic energy dissipation is typically $\lesssim 10^{-18}$ J/shift. (auth)

1253 JOSEPHSON JUNCTION MILLIMETER MICROWAVE SOURCE AND HOMODYNE DETECTOR. Ulrich, B. T.; Kluth, E. O. (Univ. of Texas, Austin). Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 1, 51-54(Jan 1973).

A millimeter and submillimeter microwave source is described in which a point-contact Josephson junction is used as both the emitter and as a homodyne detector of the microwave radiation. The microwave radiation is conveyed from the Josephson junction to the room-temperature environment outside the Dewar of liquid helium by an oversize waveguide. A room-temperature Fabry–Perot resonator refocuses the radiation on the oversize waveguide which returns the radiation to the emitting junction which also serves as a coherent detector with sensitivity 10^{-15} W/$\sqrt{\text{Hz}}$. The detector is sufficiently sensitive that the emitted power of 10^{-12} W can be detected with high signal-to-noise ratio. Power required by the junction is of the order 10^{-6} W from the bias supply. For the experiments reported, the wavelength of the emission could be varied over discrete wavelengths between 1.1 and 2.6 mm by varying the voltage bias across the junction. These wavelengths corre-

sponded to the resonant frequencies of a cavity tightly coupled to the Josephson junction, and the frequencies can be changed by modifying the geometry of the cavity. (auth)

1254 COMPARATIVE STUDIES OF NOISE LIMITATIONS IN SUPERCONDUCTING THIN-FILM RADIATION DETECTORS. Katz, R. M.; Rose, K. (Rensselaer Polytechnic Inst., Troy, NY). Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 1, 55-58(Jan 1973).

Measurements are reported on the noise limitations of superconducting thin films operating as thermal detectors (bolometers) and as current-dependent detectors. By making measurements in each mode on the same film it is possible to make a comparative study of the noise limitations for both detection mechanisms in the same device. Thin tin films with normal state sheet resistances on the order of 100 Ω per square have been studied. The devices were scribed to produce total normal state resistances on the order of 10 kΩ and were mounted in the vacuum chamber of a demountable tail Dewar so that they were not in direct contact with liquid helium. The resulting bolometers have response times and sensitivities similar to those of Martin and Bloor. The dominant noise mechanisms we have observed appear to be Johnson noise in the thermal mode and 1/f noise in the current mode. These results confirm previous conclusions regarding the sensitivity of these films as radiation detectors. (auth)

1255 $^{3}He-^{4}He$ DILUTION REFRIGERATOR CRYOSTAT SYSTEM FOR NUCLEAR ORIENTATION EXPERIMENTS. Becker, A. J.; Henrikson, H. E.; Cook, D. C. (California Inst. of Tech., Pasadena). Nucl. Instrum. Methods; 108: No. 2, 291-296(1973).

A description is given of a system which has been used to cool radioactive sources to temperatures in the vicinity of 15 mK. A special aspect of the design is a set of easily demountable aluminum shields with a maximum diameter of 5 cm around the source and with beryllium windows for the transmission of low-energy photons. Two pairs of superconducting coils are used to produce a rotatable magnetic field at the source. (auth)

1256 SUPERCONDUCTING MAGNETIC FLUX COMPRESSOR. Rose Innes, A. C. (Univ. of Manchester, Eng.). Cryogenics; 13: No. 2, 103-105(Feb 1973).

The design and operation of a mechanical superconducting flux compressor are described. The compressor is constructed of movable interleaved plates, rather like a variable capacitor. Increasing the overlap of the two sets of plates decreases the size of a hole in which magnetic flux is trapped, thus increasing the flux density. (auth)

1257 USE OF SUPERCONDUCTORS IN THERMAL INSULATIONS. Jones, M. C. (National Bureau of Standards, Boulder, CO). Cryogenics; 13: No. 2, 83-84(Feb 1973).

A suggestion is made for using superconductors as thermal radiation shields at or below liquid helium temperatures. Calculations are described which predict total emissivities for niobium of 10^{-4} to 10^{-5} at 4 K and 10^{-6} to 10^{-7} for temperatures of 1 to 2 K. (auth)

1258 LOW TEMPERATURE UHF NMR SYSTEM. Sullivan, N. S.; Pound, R. V. (Harvard Univ., Cambridge, MA). Cryogenics; 13: No. 1, 28-29(Jan 1973).

A system for the observation of NMR at temperatures below 100 mK is described. The uhf sample chamber forms an integral part of a dilution refrigerator. (auth)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 773, 776, and 869.

1259 (AEEW-R-804) GOG B: AN IMPROVED TWO DIMENSIONAL MULTIGROUP DIFFUSION CODE. Brittain, I. (Atomic Energy Establishment, Winfrith (England)). 5 Jul 1972. 43p. Dep. NTIS (U. S. Sales Only) $4.25.

GOG is a general multi-group, first-order finite-difference diffusion code for XY and RZ geometries. The neutron balance equations are solved in either the static mode eigenvalue of fixed external source form, using the normal fission source iteration scheme with well tried and reliable acceleration techniques. The version described here, written in FORTRAN IV, represents a considerable improvement over the original code in both speed and flexibility. Automatic updating of the acceleration parameters without interruption of the normal iterations is now standard. Additional features include an adjoint flux option, free format input using codewords and, optionally, material data from magnetic tape, translational boundary conditions, β factors for multi-cell WIMS, and ability to calculate higher harmonics of the static mode problem. (auth)

1260 (EUR-4948) "GAP" CODE FOR THE PREPARATION AND MODIFICATION OF THE LIBRARY FOR THE PINOCCHIO AND HEROIC CODES. Daolio, C. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Apr 1973. 62p. (In Italian). Dep. NTIS (U. S. Sales Only) $5.25. EUR-BF-85.-.

The GAP code is a code used to prepare, or to modify, the library of neutron cross sections for the PINOCCHIO and HEROIC codes. The code is a modified version of the GAM-II and GATHER-II codes. (2 tables) (auth)

1261 (IAE-2144) PROGRAM OF CALCULATING THERMAL UTILIZATION COEFFICIENT OF NEUTRONS IN MULTIREGION CYLINDRICAL CELL 3 (PRAKTINETS 3). Part 2. Description of the Program. Sultanov, N. V. (Gosudarstvennyi Komitet Po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Atomnoi Energii). 1971. 24p. (In Russian). INIS.

The program PRAKTINETS 3 is a simplification of the program PRAKTINETS 2 with the goal of accelerating the calculation of the characteristics of a multiregion cylindrical cell in G_1 and G_3. The latter are approximations of the method of surface pseudo-sources. A Boltzmann one-velocity equation was solved assuming isotropic and linear-anisotropic neutron scattering. Neutron sources, absorption cross sections, and scattering cross sections were constant throughout the region of the cell. The neutron flux at the outer boundary was assigned a value of 0, but may differ from 0. The program PRAKTINETS 3 and its text were written in ALGOL-60. (tr-auth)

1262 (JAERI-M-4766) ARGO: A ONE-DIMENSIONAL DIFFUSION CODE FOR MULTIGROUP KINETICS PARAMETER CALCULATIONS. Ikawa, K. (Japan Atomic Energy Research Inst., Tokyo). Mar 1972. 57p. NTIS (U. S. Sales Only).

ARGO is a one-dimensional (slab, cylinder, sphere), multigroup diffusion code for fast-reactor criticality and kinetics parameter analysis. It is designed primarily for the parametric survey. Three cross-section sets, i.e., JAERI-FAST-SET, ABBN-SET, and RCBN-SET, of 25 energy groups can be used in the code. Its programming is all in FORTRAN-IV. The code requires a 64k core and three peripheral storage units, one of which is used for the microscopic cross-section library. The code and its input format are described. (auth)

1263 (JAERI-M-4927) GROUP CONSTANTS FOR ^{232}Th WITH 70 AND 25 GROUP STRUCTURES. Nakagawa, M.; Nishihara, H.; Miki, K. (Japan Atomic Energy Research Inst., Tokyo). Aug 1972. 22p. (In Japanese).

Group constants for ^{232}Th are calculated and tabulated in the form of JAERI FAST set. Nuclear data used are from the ENDF/B-2 file, and the calculational methods developed for JAERI FAST set are used. The energy region, 46.5 keV ~ 3.93 keV, is treated as an unresolved resonance region, and the resonance parameters are generated by a statistical method. The effective cross sections are averaged with fission spectrum and 1/E spectrum above 46.5 keV and ultrafine spectrum below 46.5 keV. A comparison is made between the present and the conventional sets. (auth)

1264 (JAERI-M-4989) 2DF-JAERI: A TWO-DIMENSIONAL TRANSPORT CODE USING THE JAERI-FAST SET. Nishimura, H. (Japan Atomic Energy Research Inst., Tokyo). Sep 1972. 19p. NTIS (U. S. Sales Only).

The code 2DF, which solves the transport equation by the S_N method in two-dimensional XY, RZ, and Rθ geometries, has been improved so that the JAERI-FAST set can be used. The code contains SIMPLE-D, a one-dimensional diffusion and perturbation code, which collapses the 25-group cross sections into a few groups. Using the collapsed cross sections, the cross sections for the transport calculations are prepared similarly to the case of DTF-4-J, a one-dimensional transport code. The code has variable dimensions for the transport calculations and a problem having 40×44 meshes and 6 groups, for example, can be solved. The code is prepared for CDC 3600 and CDC 6600. The report describes the input data and their formats, and a test problem and its results. (auth)

1265 (JAERI-M-4990) SIMPLE-D (No. 4): ONE DIMENSIONAL DIFFUSION AND PERTURBATION CODE. Nishimura, H. (Japan Atomic Energy Research Inst., Tokyo). Sep 1972. 46p. NTIS (U. S. Sales Only).

The SIMPLE-D, a one-dimensional perturbation code, is linked with EXPANDA-4, a one-dimensional diffusion code. And it has the following features. (1) Usage of the JAERI-FAST, RCBN, and ABBN sets. (2) Dealing with the heterogeneity effects of fuel elements by an equivalence relation. (3) Computation of the nuclear characteristics of a central void reactor. (4) Use of $J^- = 0$ as the boundary condition of the system. The report describes theories in the code, the results of calculations for the ZPR-III-48 and the JEZEBEL cores, the input data and their formats, and the output data. (auth)

1266 (JAERI-M-4991) DTF-4-J: A ONE-DIMENSIONAL TRANSPORT CODE USING THE JAERI-FAST, ABBN, AND RCBN SETS. Nishimura, H. (Japan Atomic Energy Research Inst., Tokyo). Sep 1972. 35p. NTIS (U. S. Sales Only).

The code DTF-4-J consists of two parts, i.e., preparation of the transport cross sections with the JAERI-FAST, ABBN, or RCBN set, and solving the neutron transport equation by the S_N method in one-dimensional plane, cylindrical, and spherical geometries. It is prepared for FACOM230/60, IBM 360/75, and CDC 3600. The input data and their formats for the respective computers are described, and also the results of calculations for the ZPR-III-48 core. (auth)

1267 (JAERI-M-4992) CALCULATION OF THE SECOND-ORDER PERTURBATION TERMS USING THE GENERALIZED PERTURBATION METHOD. Seki, Y. (Japan Atomic Energy Research Inst., Tokyo). Sep 1972. 22p. (In Japanese). NTIS (U. S. Sales Only).

The generalized perturbation method is generally used to calculate the change of the reactor integral quantities in the form of the ratio of the functionals of neutron flux and/or adjoint neutron flux caused by perturbations given to the reactor parameters. It is useful in calculating the change of an integral quantity under various perturbed states, but is not so in obtaining the change of a number of the integral quantities each of which is caused by different perturbations of the reactor parameters. This is because in the method, calculation of the so-called generalized neutron fluxes (and/or generalized adjoint neutron fluxes) corresponding to each of the integral quantities is required and, further, due to the source iteration in obtaining the generalized neutron fluxes many iterative calculations are necessary for high accuracy. From the study of characteristics of the generalized neutron fluxes, it is shown that the reasonable accuracy may be obtained by a relatively small number of the iterative calculations. The limiting conditions in the generalized perturbation method that the unperturbed state should be critical and that the perturbation be given so as to conserve criticality of the system are eliminated in the modification described. The formulation to give the second-order perturbation terms in a reaction component-wise manner is also developed. Using this formulation, analysis of the first-order perturbation errors may be performed effectively. (auth)

1268 (JAERI-M-4999) MXSFIT: A CODE FOR FITTING THE RESONANCE CROSS SECTION BY MULTI-LEVEL FORMULA. Takano, H.; Kobayashi, K. (Japan Atomic Energy Research Inst., Tokyo). Oct 1972. 24p. (In Japanese). NTIS (U. S. Sales Only).

The MXSFIT code is the program for fitting the microscopic cross sections based on the multi-level formula. The program computes the differences between the measured cross sections and cross sections obtained using single-level parameters, then least square fitting is made for above differences by the expression taking account of the interference effect between the resonance levels which is derived from R-matrix theory. The expression consists of summations of symmetric and asymmetric line shape functions. The multi-level fitting parameters introduced have positive

as well as negative values. The results of fitting for ^{235}U and ^{233}U fission cross sections and ^{238}U total cross sections are shown and discussed. The comparison of the experiments and calculation results can be done using the plotter routine, if necessary. (auth)

1269 (LA-4751) MCN: A NEUTRON MONTE CARLO CODE. Cashwell, E. D.; Neergaard, J. R.; Taylor, W. M.; Turner, G. D. (Los Alamos Scientific Lab., N. Mex.). Jan 1972. Contract W-7405-eng-36. 35p. Dep. NTIS $3.75.

The general purpose Monte Carlo neutron code MCN is described in detail to help the user set up and run his own problems. The code treats general three-dimensional geometric configurations of materials, and can use point cross-section data in either the Livermore (LLL) or the Aldermaston (AWRE) format. Optional standard variance reduction techniques are built into the code. Source information may be inserted in complete generality, although certain standard sources are included. Neutron thermalization is treated by a free-gas model. In this treatment, light nuclei are assumed to have a Maxwellian velocity distribution with spatially dependent temperatures that may also vary with time. Standard output includes current and fluxes across arbitrary surfaces in the problem, average fluxes in designated cells, fluxes at each of a set of point detectors in space, and the number of particles captured in a cell as a function of energy and time. A sample problem is described and set up, and the complete computer listing of a trial run is given. (auth)

1270 (LA-UR-73-479) TRIANGULAR MESH METHODS FOR THE NEUTRON TRANSPORT EQUATION. Reed, W. H.; Hill, T. R. (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract W-7405-eng-36. 23p. (CONF-730414-2). Dep. NTIS $3.25.

From American Nuclear Society meeting; Ann Arbor, MI (8 Apr 1973).

Methods are developed for differencing the discrete ordinates equations on a triangular x−y grid based on piecewise polynomial representations of the angular flux. The first class of methods discussed assumes continuity of the angular flux across all triangle interfaces. A second class of methods, which is shown to be superior to the first class, allows the angular flux to be discontinuous across triangle boundaries. Numerical results illustrating the accuracy and stability of these methods are presented, and numerical comparisons between the above two classes of methods are made. The effectiveness of a fine mesh rebalance acceleration technique is also discussed. (auth)

1271 (ORNL-TM-4041) COMPARISON OF THE GROUP CONSTANTS GENERATED BY THE ENDF/B PROCESSING CODES ETOX AND SUPERTOG. Wright, R. Q.; Schenter, R. E.; Jenkins, J. D. (Oak Ridge National Lab., Tenn.). Apr 1973. Contract W-7405-eng-26. 14p. (ENDF-184). Dep. NTIS $3.00.

A detailed comparison of the group constants generated by the ENDF/B processing codes, ETOX and SUPERTOG, is made for total, elastic, inelastic, fission, $\bar{\nu}$, and capture infinite dilute, average cross sections. The weighting is 1/E for 68 groups with equal 0.25 lethargy spacing between 10 MeV and 0.414 eV. The study was limited to the three important nuclides ^{235}U, ^{238}U, and ^{239}Pu, material numbers 1102, 1103, and 1104 from ENDF/B tape 201. The major accomplishments of this study were to reach agreement on how to process the ENDF/B unresolved resonance parameters and to eliminate substantial differences in the resolved resonance region. In the process of resolving differences between the two codes, several errors were found and eliminated, and the group constants from ETOX and SUPERTOG are now in excellent agreement. (auth)

1272 (ORNL-TM-4169) ORNL BENCHMARK EXPERIMENT FOR NEUTRON TRANSPORT IN IRON AND STAINLESS STEEL. Maerker, R. E.; Muckenthaler, F. J. (Oak Ridge National Lab., Tenn.). Apr 1973. Contract W-7405-eng-26. 49p. Dep. NTIS $3.00.

A description is presented of an experiment performed at the Tower Shielding Facility which provides verification of the accuracy of the available neutron cross sections for use in transport calculations of deep penetration of neutrons through up to 3 ft of iron and 18 in. of stainless steel. Calculations of the experiment were performed with a special version of the MORSE multigroup Monte Carlo code which uses point total cross sections. Comparison of the calculations using the new MAT 4180-mod 1 iron cross-section set with experiment indicates that the absolute neutron leakage spectra above thermal energies arising from scattering that penetrate up to 1 ft of iron or 18 in. of stainless steel can be calculated to within about 20%, and the total neutron leakage above thermal energies penetrating up to 3 ft of iron can also be calculated to about the same accuracy. (auth)

1273 (RT/FIMA-(72)7) ALGORITHMS FOR DISCRETE GEOMETRY IN MONTE CARLO TRANSPORT PROBLEMS. De Matteis, A.; Guzinski, W. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 24 Oct 1972. 22p. Dep. NTIS (U. S. Sales Only) $3.25.

Two Fortran routines are given for discrete representation of planar regions in the computer memory and simulation of particle free flights through these regions for use in Monte Carlo transport problems. Geometrical configurations considered are those which can be described by the superimposition of circles and convex polygons. Periodicity for infinite lattices of rectangular or hexagonal cells is also taken into account. (auth)

1274 VERIFYING A NEUTRON DIFFUSION THEORY IN MEDIA WITH CAVITIES BY A PULSED NEUTRON TECHNIQUE (SINGLE CAVITY IN A MODERATOR BLOCK). Zhezherun. I. F. At. Energ. (USSR); 34: No. 3, 171-175(Mar 1973). (In Russian).

There is described a method of neutron diffusion investigation in anisotropic media by means of a simple system—a single cavity in a moderator block. Pulsed neutron experiments with a number of blocks containing various cavities indicate that it is possible to reliably measure in such systems the axial neutron diffusion coefficient D_{11} and its dependence on cavity length. The measured D_{11} may be easily recalculated for a lattice of cavities. In comparison with ordinary measurements of D_{11} in blocks with a lattice of cavities the method is more sensitive and requires less time and material. (1 figure, 1 table and 10 references.) (auth)

1275 CREATION OF γ-RADIOACTIVE ISOTOPES IN SOIL UNDER THE ACTION OF NEUTRONS HAVING ENERGIES UP TO 1 GeV. Aleksandrov, A. A.; Gel'fand, E. K.; Man'ko, B. V.; Mironov, Yu. T.; Sychev, B. S.; Ushakov, S. I. At. Energ. (USSR); 34: No. 3, 177-179(Mar 1973). (In Russian).

Specific activities of long-life γ-radioactive isotopes induced in soil by neutrons having energies up to 1 GeV were measured. The isotopes ^{7}Be, ^{22}Na, ^{46}Sc, and ^{54}Mn were observed. The experimental data agree satisfactorily with calculated values. The quantity of radioactivity washed out from the soil by water was measured. The largest value of wash-out factor (20%) was obtained for the isotope ^{22}Na. (10 references, 3 tables.) (auth)

1276 PULSED NEUTRON EXPERIMENT IN D_2O WATER AND ICE. Boroson, H. R. College Park, MD; Univ. of Maryland (1972). 312p. University Microfilms Order No. 73-9679. Thesis (Ph. D.).

This work describes the first extensive pulsed neutron experiment in heavy water spanning the phase change from +40°C to −50°C in ice. Values for the diffusion coefficient, D_0, and the cooling coefficient, C, were calculated from measurements obtained over a range of buckling from .03 to .05 cm^{-2}. Correlation with past measurements in water was very good. Support was obtained from sparse earlier indications of low values for the diffusion parameters below +50°C and approaching the ice phase. These values are lower than would be predicted by straight-line extrapolation from measurements at higher temperatures. There was insufficient evidence from which to conclude that a real discontinuity in D_0 exists at the phase change. It is considerably more likely that a discontinuity does exist in C, related to the high coherent scattering and crystalline-type behavior of heavy water. (Diss. Abstr. Int., B)

1277 NUMERICAL METHODS OF HIGH ORDER ACCURACY FOR ONE DIMENSIONAL DIFFUSION EQUATION. Hennart, J. P. (Univ. Libre, Brussels). Nucl. Sci. Eng.; 50: No. 3, 185-199(Mar 1973).

The classical Rayleigh−Ritz procedure is applied to the variational formulation of the one-dimensional diffusion equation. By minimizing the corresponding functional over finite dimensional piecewise cubic and quintic spaces, generalizations of the classical finite difference schemes are derived in the domain of continuous variables. Error estimates in the continuous norm are established which compare very favorably with corresponding ones in the discrete norm. (auth)

1278 NEUTRON DIFFUSION COEFFICIENT AS A SECOND-ORDER TENSOR: THEORY AND CALCULATIONS. Boffi, V. C. (Univ., Bologna); Trombetti, T. Nucl. Sci. Eng.; 50: No. 3, 200-207(Mar 1973).

A new definition is given of the diffusion coefficient as a second-order tensor fully describing the anisotropic character of neutron diffusion in a homogeneous convex body. Numerical values for the diffusion coefficient tensor are reported for some typical geometries. (auth)

1279 BILINEAR FORMULATION FOR SPATIAL CROSS-SECTION AVERAGING. Komata, M. (Central Research Inst. of Electric Power Industry, Tokyo); Nicholson, R. B.; Page, E. M. Nucl. Sci. Eng.; 50: No. 3, 220-228(Mar 1973).

The bilinear method of cell averaging of the neutron cross sections developed by Nicholson from the variational principle has been explained and supported by a perturbation theory der-

ivation. By introducing further approximations, a form of the method is derived which involves only the scalar fluxes and adjoints and the currents. The scalar form differs from that used previously by others. A physical explanation is given for the flux gradient term which leads to a pseudo-absorption effect. (auth)

1280 FORMATION OF NEUTRONS BY COSMIC RADIATION AT VARIOUS DEPTHS WITHIN THE EARTH. Gorshkov, G. V.; Zyabkin, V. A. At. Energ. (USSR); 34: No. 3, 210-213(Mar 1973). (In Russian).

The neutron production rate was measured in Pb, rock, Fe, and Al at depths up to 1000 m under the action of components of cosmic radiation, slow negative μ-mesons, and high-energy μ-mesons. The results are displayed graphically. Since Al and granite have similar characteristics (average atomic weight, density), data from Al measurements may be used for evaluating the rate of production of neutrons in granite by cosmic rays, and thence the natural radioactivity in granite. (KSW)

1281 COHERENT SCATTERING FUNCTION OF LIQUID ARGON AT 85.2°K. Rowe, J. M. (Argonne National Lab., IL). pp 413-433 of Neutron Inelastic Scattering, 1972. Vienna; International Atomic Energy Agency (1972).

From Fifth IAEA Symposium on Nuetron Inelastic Scattering; Grenoble, France (6 Mar 1972). See STI/PUB-308; CONF-720304-.

The coherent scattering function $S(Q,E)$ of liquid argon at 85.2°K obtained from a recent neutron scattering experiment is compared in detail to several theoretical models. As the incoherent scattering function $S_s(Q,E)$ was obtained separately from the neutron experiment, one is also able to test models which relate $S(Q,E)$ to $S_s(Q,E)$. To make the comparison quantitative, root-mean-square deviations of each model were computed from the data for four specific quantities derived from $S(Q,E)$: $S(Q,0)$; the full width at half maximum of $S(Q,E)$; the peak value of $E^2 \cdot S(Q,E)$; and the value of E for which this peak occurs. It is shown that it is essential to consider that all of these quantities as results derived from less complete comparison can be misleading. The primary result of this work is that none of the models tested gives a completely adequate representation of the data, even though two of the models have parameters which were chosen by fitting to the data. From the comparison of the models to the four quantities listed above, it is found that an exponential form for the current-current correlation memory function gives a better overall representation of the data than does a Gaussian form. This result is contrary to the conclusions reached by other authors from consideration of only $E^2 \cdot S(Q,E)$. (7 figures, 3 tables) (auth)

1282 MULTIDIRECTIONAL MODAL REPRESENTATION FOR NEUTRON TRANSPORT ANALYSIS. Harms, A. A. (McMaster Univ., Hamilton, Ont.); Kushneriuk, S. A. Nucl. Sci. Eng.; 51: No. 1, 76-78(May 1973).

A general multidirectional modal representation for the angular density of the one-speed neutron transport equation is discussed. The properties of orthogonality and recurrence are presented together with expressions for several neutronic parameters. The system of equations for the spatial moments are established and certain features described. It is shown that some known solution formulations are special cases of this more general representation. (auth)

1283 ENERGY DISTRIBUTION OF DELAYED FISSION NEUTRONS. Shalev, S.; Cuttler, J. M. (Technion-Israel Inst. of Tech., Haifa). Nucl. Sci. Eng., 51: No. 1, 52-66(May 1973).

A high-pressure ^{3}He proportional counter was developed with good energy resolution for fast neutrons, and detailed descriptions are given of its construction and calibration and the determination of its response function. The spectrometer was used to measure the delayed-neutron energy distribution for samples of ^{232}Th, ^{233}U, ^{235}U, ^{238}U, and ^{239}Pu repetitively irradiated in the Israel Research Reactor-1. Irradiation and counting times were optimized to accentuate group 2 and group 4 delayed neutrons. Corrections were applied for the finite energy resolution, for the energy-dependent detection efficiency and for spectrum distortion due to gamma rays. An approximate energy spectrum was obtained from group-1 delayed neutrons, and more precise spectra were obtained for group-2 delayed neutrons from each of the samples investigated. Preliminary results are also given for group-4 delayed neutrons from ^{232}Th and ^{235}U. (auth)

1284 SIMPLE ANALYTIC TRANSIENT FLUX EXPRESSION FOR USE WITH ASYMPTOTIC DIFFUSION THEORY. Beghian, L. E.; Forbes, I. A.; Rogers, V. C. (Lowell Technological Inst., MA). Nucl. Sci. Eng.; 51: No. 1, 78-83(May 1973).

The monoenergetic integral transport equation is solved in an approximate manner by separating the integral into an asymptotic component plus a transient boundary component. Solutions to the resulting equation are obtained with only a modest increase in complexity over diffusion theory. The method is illustrated by several examples in which significant improvement over diffusion theory is obtained. (auth)

Nuclear Properties and Reactions, $A \leq 5$

Refer also to abstracts 857, 1131, 1339, and 1349.

1285 EXCHANGE MAGNETIC MOMENT FORM FACTOR OF THE THREE NUCLEON SYSTEM. Okamoto, K. (Univ. of New South Wales, Kensington, Australia); Horiike, M. Phys. Lett.; 44B: No. 1, 29-32(2 Apr 1973).

The exchange magnetic moment form factor of ^{3}H and ^{3}He is derived from experiment, regarding the D state probability P_D as free parameter. The isoscalar part is roughly constant. The rms radius corresponding to the isovector part increases as P_D increases. (auth)

1286 PION PHOTOPRODUCTION ON ^{3}He AT AND ABOVE THE 3-3 RESONANCE. Bachelier, D.; Bernas, M.; Boyard, J. L.; Jourdain, J. C.; Radvanyi, P. (Institut de Physique Nucleaire, Orsay, France). Phys. Lett.; 44B: No. 1, 44-46 (2 Apr 1973).

The differential cross section for the ^{3}He$(\gamma,\pi^+)^3$H reaction was measured at fixed values of q^2 in the region of the first resonance, and at fixed θ_π versus q^2 up to 13 fm^{-2}. The observed shift of the resonance towards lower energies, and the absence of a minimum near 11.6 fm^{-2} might be explained by recent theoretical calculations. (auth)

1287 FAST NEUTRON DOUBLE SCATTERING FROM ^{4}He. Tornow, W.; Mack, G.; Mertens, G.; Spiegelhauer, H. (Univ., Tuebingen, Ger.). Phys. Lett.; 44B: No. 1, 53-54 (2 Apr 1973).

The asymmetry of 15 MeV neutrons was measured after successive scattering from two high-pressure helium gas scintillators. The experimental result is compared with predictions of various n-^{4}He phase shift sets. The phases of Hoop and Barschall and of Satchler et al. agree best with the experiment. (auth)

1288 NEUTRON-NEUTRON SCATTERING LENGTH FROM A COMPLETE EXPERIMENT ON THE ^{3}H(d,2n)^{3}He REACTION AT 8.45 MeV. Jeremie, H.; Larose-Poutissou, R. (Univ. of Montreal). Phys. Lett.; 44B: No. 1, 68-70(2 Apr 1973).

The spectrum of the time-differences between the two neutrons from the ^{3}H(d,2n)^{3}He reaction detected by two plastic scintillators situated at 0.2 and 2.0 m from the target was measured at 0°. The spectrum was compared with a Jost-function final-state interaction enhancement factor and yielded a value of 16.2 ± 1.2 fm for a_{n-n}, the neutron-neutron scattering length. (auth)

1289 NEUTRON DIFFERENTIAL ELASTIC SCATTERING CROSS SECTION FOR DEUTERIUM FROM 15 TO 18 MEV. Moore, J. D. M. Auburn, AL; Auburn Univ. (1972). 93p. University Microfilms Order No. 73-9797.

Thesis (Ph. D.).

The differential cross section for the elastic scattering of neutrons by deuterons was measured at neutron energies of 15.58, 15.83, 16.31, 16.75, and 17.54 MeV. The neutron source was the T(d,n)^{4}He reaction. The neutrons were scattered in a deuterated benzene scintillator, and were subsequently detected in another liquid scintillator. Pulse-shape discrimination was used to identify the scattered neutrons, while their energy was determined by measuring their flight time from scatterer to detector. The data were normalized, by the use of a 50-percent deuterated benzene scatterer, to the proton cross section. Corrections were made for the relative efficiency of the neutron detector and for multiple interaction effects in the scatterer. (Diss. Abstr. Int., B)

1290 CLUSTER STRUCTURE AND INELASTIC INTERACTIONS OF FAST PROTONS WITH A LIGHT NUCLEUS. Abdinov, O. B. (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk Azerb. SSR, Ser. Fiz.-Tekh. Mat. Nauk; No. 2, 119-122 (1972). (In Russian).

Different variants were checked out which provide a means of calculating the distribution of α-clusters both about the radius of the nucleus and along the number of α-associations in the nucleus. The best agreement with experiment resulted when the number of α-clusters in a nucleus of carbon was equal to ~0.6, corresponding to the probability of coagulating nucleons in α-clusters ~20%, arranged principally at the periphery of the nucleus. The model dis-

cussed was successfully used for calculations of the interaction of high energy particles with light nuclei. (KSW)

1291 EFFECTS OF EXCHANGE, FINAL-STATE INTERACTIONS, AND DISTORTED WAVES IN THE REACTIONS ^{2}H(^{3}He, ^{3}H p)p AND ^{2}H(^{3}He,^{3}He p)n. Warner, R. E.; Vogt, E. W. (Oxford Univ.). Nucl. Phys.; A204: No. 3, 433-453(1973).

A systematic treatment of the ^{2}H(^{3}He, ^{3}H p)p and ^{2}H(^{3}He, ^{3}He p)n reactions by the Born approximation is carried out for conditions at which spectator peaks were observed juxtaposed with final-state interaction (FSI) effects. The spectator peaks were fitted with the plane-wave Born approximation (PWBA) by using two interaction matrix elements, but difficulties were encountered in predicting relative yields, absolute cross sections, and the shape modifications due to FSI. Full antisymmetry is first added to PWBA in order to account properly for relative yields. This step connects all reaction mechanisms (break-up, knock-out, and pick-up) and their seven distinct interaction matrix elements. Next, the FSI shape modifications are successfully accounted for by using scattering wave functions for the final free nucleons in one of the matrix elements and by inferring the FSI properties in all matrix elements through a scattering-length approximation. When juxtaposed to simple spectator poles, the FSI effects are shown to be interesting interference dips and amplitude peaks, which are dominated by the sign and size of the singlet and triplet nucleon–nucleon scattering lengths. Finally, the effects of distorted waves on absolute cross sections are briefly discussed. (7 figures) (auth)

1292 PHOTODISINTEGRATION OF ^{4}He. Wait, G. D. Saskatoon, Saskatchewan; Univ. of Saskatchewan (1972). 137p. University Microfilms Order No. 73-8137.

Thesis (Ph. D.).

Total and differential cross sections were measured for the reactions ^{4}He(γ,t)H from 32 MeV to 72 MeV excitation energy, ^{4}He(γ,^{3}He)n from 48 to 83 MeV and ^{4}He(γ,p)^{3}H from 23 to 35 MeV. A ^{4}He gas target was bombarded with 91.3 MeV electrons and all charged particles resulting from the breakup of ^{4}He were detected using a magnetic spectrometer and solid state detectors. The photodisintegration cross sections were obtained from the electrodisintegration cross sections and the virtual photon spectrum. The total cross sections agree well with previous experiments except at low energies where the contributions due to multiparticle final states were included in the measurement. The total photoneutron cross section is the same as the photoproton cross section, within experimental uncertainties, as expected from the dominance of E1 transitions. The proton angular distributions show a monotonic increase in forward peaking with increasing energy consistent with a relative increase in the E2 transitions. The neutron angular distribution is peaked backward at 48 MeV but becomes forward peaked above 53 MeV. This change in phase of the neutron asymmetry cannot be explained in terms of a simple E1-E2 interference. It is suggested that short range correlations might be important at higher excitation energies. The experimental data is compared with available theoretical calculations. (Diss. Abstr. Int., B)

Nuclear Properties and Reactions, 6 ≤ A ≤ 19

Refer also to abstracts 1131, 1339, 1347, 1349, 1357, 1398, 1425, and 1427.

1293 (CONF-720669-, pp 1-37) NUCLEAR MOLECULES IN HEAVY-ION SCATTERING. Greiner, W. (Univ., Frankfurt am Main). 1972.

In proceedings of heavy-ion summer study.

1294 (CONF-720669-, pp 315-336) HIGH-RESOLUTION HEAVY ION REACTION STUDIES. Middleton, R. (Univ. of Pennsylvania, Philadelphia). 1972.

In proceedings of heavy-ion summer study.

1295 (CONF-720669-, pp 337-352) THEORY OF TRANSFER REACTIONS WITH HEAVY IONS. Goldfarb, L. J. B. (Univ. of Manchester, Eng.). 1972.

In proceedings of heavy-ion summer study.

1296 (CONF-720669-, pp 353-377) NUCLEAR SPECTROSCOPY WITH HEAVY-ION REACTIONS. Fortune, H. T. (Univ. of Pennsylvania, Philadelphia). 1972.

In proceedings of heavy-ion summer study.

1297 (CONF-720669-, pp 438-451) HYPERFINE INTERACTIONS IN HYDROGEN-LIKE IONS. Goldring, G. (Weizmann Inst. of Science, Rehobot, Israel). 1972.

In proceedings of heavy-ion summer study.

1298 (FEI-261) INTRODUCTION OF DATA ON PHOTODISINTEGRATION OF NUCLEI INTO CALCULATIONS OF AVERAGE CROSS SECTIONS FOR RADIATIVE CAPTURE. Yadrovskii, E. L. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko Energeticheskii Institut). 1971. 6p. (In Russian). INIS.

Questions on the introduction of data on photoabsorption into calculations of mean radiative widths were examined. During the calculation of the mean radiative widths giant dipole resonance effects were obtained. In the one-particle approximation the intensities of the dipole transition are uniformly distributed in the energy interval approximately from 5 to 15 MeV. The residual nuclear interaction between nucleons leads to transfer of the intensity into one coherent giant dipole resonance level located at $E_\gamma \cong 15$ MeV. Experimental data on the giant dipole resonance and the cross section for photoabsorption were given. As there is still no agreement between theory and experiment, in the calculation of the mean capture cross section it is necessary to relate very critically to the assumptions taken in the calculations. Moreover, it is necessary to discount supplementary resonances in the photoabsorption cross section. (tr-INIS)

1299 PROTON SCATTERING FROM ^{9}Be BETWEEN 6 AND 30 MeV. Votava, H. J. Chapel Hill, NC; Univ. of North Carolina (1972). 203p. University Microfilms Order No. 73-4885.

Thesis (Ph. D).

Differential cross section excitation functions at lab scattering angles 86.9°, 120.0°, 140.0°, and 160.0° were measured for ^{9}Be $(p,p_0)^9$Be, ^{9}Be$(p,p_2)^9$Be, and ^{9}Be$(p,d_0)^8$Be from 6 to 15 MeV proton lab energy in 100 keV steps. An anomaly near 6.7 MeV, corresponding to 12.6 MeV excitation in the compound nucleus ^{10}B, was observed in the ^{9}Be$(p,p_0)^9$Be excitation curves and was analyzed along with a neutron threshold in ^{9}Be$(p,n_4)^9$B at 6.55 MeV with an excited-state-threshold resonance theory using energy dependent Breit–Wigner resonance parameters Γ(E) and E_0(E). Non-optical-model off-resonance cross sections were needed to fit the resonant cross-section shapes and magnitudes. A probable spin-parity assignment of (2^+) for the 12.6 MeV level in ^{10}B and probable spin-parity assignments $(^3/_2{}^+,^5/_2{}^+)$ for the 4.05 MeV level in ^{9}B were made. The 6.7 MeV resonance suggests that the optical-model is inapplicable to ^{9}Be$(p,p_0)^9$Be below 10 MeV. Differential cross-section angular distributions were measured for ^{9}Be$(p,p_0)^9$Be and ^{9}Be$(p,p_2)^9$Be at proton lab energies of 13.0, 14.0, 15.0, 21.35, and 30.3 MeV and for ^{9}Be$(p,d_0)^8$Be at 13.0, 14.0, 15.0, and 21.35 MeV. Angular distributions of polarizations for ^{9}Be$(\vec{p},p_0)^9$Be and of analyzing powers for ^{9}Be$(\vec{p},p_2)^9$Be and ^{9}Be$(\vec{p},d_0)^8$Be were also measured at 13.0 and 15.0 MeV. A spherical optical-model (SOM) analysis of ^{9}Be$(p,p_0)^9$Be angular distributions from 13.0 to 30.3 MeV showed that allowing only an energy dependence in the parameters V_R and W_S, the volume real and surface imaginary potential depths, respectively, reproduced the measurements. Elastic-scattering SOM wavefunctions for ^{9}Be$(p,p_0)^9$Be were used to calculate probability densities and flux divergences displayed in three-dimensional computer-generated plots revealing the McCarthy focus and were used to predict large local polarizations within the nuclear surface. A non-adiabatic coupled-channels (NACC) analysis was made assuming a quadrupole deformed optical-model potential and assuming that the $^3/_2{}^-$, $^5/_2{}^-$, and $^1/_2{}^-$ levels of the K = $^3/_2$ ground-state rotational band of ^{9}Be were strongly coupled. The ^{9}Be$(p,p_0)^9$Be and ^{9}Be$(p,p_2)^9$Be measurements from 13.0 to 30.3 MeV were simultaneously reproduced at each energy for a nuclear deformation of $\beta = 1.1$. The NACC fits were obtained as in the SOM case by varying only V_R and W_S with energy. Comparisons between the DWBA and NACC indicated that the former is inadequate for large deformations. Both SOM and NACC analyses in this work indicated the same energy dependence in V_R while the NACC analysis indicated W_S was 4 MeV lower than the SOM W_S at each energy of the analysis. Both SOM and NACC analysis ignored the $^3/_2$ spin of ^{9}Be and measured polarizations were reproduced using only the standard undeformed spin-orbit potential. Comparable SOM and NACC fits indicated that the SOM parameterization was able to compensate for the highly deformed surface of ^{9}Be. The SOM and NACC energy dependence in V_R and W_S in this work was consistent with other parameterizations describing elastic nucleon scattering from other nuclei. (Diss. Abstr. Int., B)

1300 ABSOLUTE NEUTRON YIELDS FROM ALPHA-PARTICLE INTERACTION WITH THICK TARGETS OF NATURAL CARBON. Bair, J. K. (Oak Ridge National Lab., TN). Nucl. Sci. Eng.; 51: No. 1, 83-84(May 1973).

Recent measurements of the neutron yield resulting from the alpha-particle bombardment of carbon disclosed an error in the data reported in the literature. New values of the thick-target yield of neutrons are ~20% of the previously reported values for alpha-particle energies between 2 and 5.3 MeV, and ~10%, between 5.3 and 9.0 MeV. (1 figure) (auth)

1301 NUCLEAR STRUCTURE EFFECTS IN THE ALLOWED MUON CAPTURE IN ^{14}N. Mukhopadhyay, N. C. (Argonne National Lab., IL). Phys. Lett.; 44B: No. 1, 33-35(2 Apr 1973).

Influences of nuclear structure on the allowed muon capture processes in ^{14}N are studied. The first 2^+(T = 1) state in ^{14}C is found to be strongly excited, followed by a moderate excitation of 1^+ state and a weak excitation of the ground state of ^{14}C. The ground state transition exhibits interesting effects of its dominance by $[\sigma \times Y^2 (\hat{r})]^1$ operator. The $(2s-1d)^2$ nuclear excitations may be responsible for the reallocation of the allowed strength to 2^+(T = 1) states. (auth)

1302 ISOBARIC ANALOGUE STATES IN ^{6}Li AND THE SOLAR NEUTRINO ANOMALY. Bishop, G. R. (Univ. of Glasgow). J. Phys., A (London); 6: No. 3, L21-L23(Mar 1973).

A search is reported for the isobaric analogue state in ^{6}Li to the state in ^{6}Be proposed recently as a possible reason for the solar neutrino anomaly. Upper limits to the radiative probability of transition to such a state are obtained. (auth)

1303 TIME-DIFFERENTIAL MEASUREMENT OF THE HYPERFINE STRUCTURE OF THE 6.13 MeV STATE IN HIGHLY IONIZED ^{16}O ATOMS. Randolph, W. L.; Ayres de Campos, N.; Beene, J. R.; Burde, J.; Grace, M. A.; Start, D. F. H.; Warner, R. E. (Oxford Univ.). Phys. Lett.; 44B: No. 1, 36-38(2 Apr 1973.

A time-differential technique was developed which makes possible the observation of time dependent effects produced by hyperfine interactions in highly ionized atoms during recoil into vacuum. Theoretical and experimental considerations of the technique are discussed and a value for $|g_I|$ of 0.55 ± 0.03 was obtained for the 6.13 MeV (3^-) state of ^{16}O. (auth)

1304 IS THE 11.95 MeV 8^+ STATE OF ^{20}Ne IN THE GROUND-STATE BAND? Fortune, H. T.; Betts, R. R.; Garrett, J. D.; Middleton, R. (Univ. of Pennsylvania, Philadelphia). Phys. Lett.; 44B: No. 1, 65-67(2 Apr 1973).

Alpha-particle reduced widths for the 8^+ state at 11.95 MeV, obtained from analysis of both ^{16}O + α resonant scattering data and ^{16}O(^{6}Li,d)^{20}Ne reaction data are consistent with expectation for the 8^+ member of the ground state rotational band. (auth)

1305 QUASI-FREE ELECTRON SCATTERING ON LIGHT NUCLEI. Hiramatsu, H. (Tokyo Univ.); Kamae, T.; Muramatsu, H.; Nakamura, K.; Izutsu, N.; Watase, Y. Phys. Lett.; 44B: No. 1, 50-52(2 Apr 1973).

The separation energy spectra and the momentum distributions obtained from the (e,e'p) reaction on ^{6}Li, ^{7}Li, ^{9}Be, and ^{12}C are presented. A simple DWIA analysis using the Elton-Swift wave functions gives good agreement with the ^{12}C data, but does not explain the data for ^{6}Li and ^{7}Li. (auth)

1306 MODEL INDEPENDENT NUCLEAR CHARGE DENSITIES FROM ELASTIC ELECTRON SCATTERING. Sick, I. (CEN, Saclay, France). Phys. Lett.; 44B: No. 1, 62-64(2 Apr 1973).

A method to derive nearly model independent charge densities from elastic electron scattering data is proposed and applied to ^{12}C and ^{32}S. (auth)

1307 ELASTIC SCATTERING OF 217-MeV ^{3}He PARTICLES. Willis, N.; Brissaud, I.; Le Bornec, Y.; Tatischeff, B.; Duhamel, G. (Institut de Physique Nucleaire, Orsay, France). Nucl. Phys.; A204: No. 3, 454-464(1973).

Differential cross sections were measured for the elastic scattering of 217-MeV ^{3}He particles by ^{6}Li, ^{9}Be, ^{12}C, ^{28}Si, ^{40}Ca, ^{58}Ni, ^{89}Y, ^{90}Zr, ^{120}Sn, and ^{208}Pb. The data were analyzed with an optical potential. The ambiguities found at lower energies (discrete families of real potential well depths) disappear. An optical potential is also calculated with an effective ^{3}He−N interaction and a matter distribution. The agreement with experiment is good. Some comparisons are made with 166-MeV α-particle elastic scattering data. (7 figures, 3 tables) (auth)

1308 PROTON SCATTERING FROM ^{9}Be BETWEEN 6 AND 30 MeV AND THE STRUCTURE OF ^{9}Be. Votava, H. J.; Clegg, T. B.; Ludwig, E. J.; Thompson, W. J. (Univ. of North Carolina, Chapel Hill). Nucl. Phys.; A204: No. 3, 529-551(1973).

Differential cross-section excitation functions at lab scattering angles 86.9°, 120.0°, 140.0°, and 160.0° were measured for ^{9}Be(p, p_0)^{9}Be, ^{9}Be(p, p_2)^{9}Be and ^{9}Be(p, d_0)^{8}Be at proton lab energies from 6 to 15 MeV in 100 keV steps. A broad anomaly was observed in the ^{9}Be(p, p_0)^{9}Be excitation functions. Differential cross-section angular distributions were measured for ^{9}Be(p, p_0)^{9}Be and ^{9}Be(p, p_2)^{9}Be at lab energies of 13.0, 14.0, 15.0, 21.35, and 30.3 MeV and for ^{9}Be(p, d_0)^{8}Be at 13.0, 14.0, 15.0, and 21.35 MeV. Angular distributions of polarization analyzing powers for ^{9}Be($\vec{p}$, p_0)^{9}Be, ^{9}Be($\vec{p}$, p_2)^{9}Be, and ^{9}Be($\vec{p}$, d_0)^{8}Be were measured at 8.0, 11.0, 12.0, 13.0, and 15.0 MeV. A spherical optical-model (SOM) analysis of the elastic scattering angular distribution data from 13.0 to 30.3 MeV showed that an energy dependence of only V_R and W_S (volume real and surface imaginary depths) is sufficient to reproduce the measurements. Coupled-channels (CC) analyses were made with a quadrupole-deformed optical-model potential and strong coupling of $\frac{3}{2}^-$, $\frac{5}{2}^-$, and $\frac{7}{2}^-$ levels of a K = $\frac{3}{2}$ ground-state rotational band of ^{9}Be. The ^{9}Be(p, p_0)^{9}Be and ^{9}Be(p, p_2)^{9}Be data from 13.0 to 30.3 MeV were analyzed simultaneously at each energy, only V_R and W_S being varied with energy, for a potential deformation of β = 1.1. Both SOM and CC analyses indicated the same energy dependence in V_R, while W_S averaged 3.5 MeV lower in CC than in SOM, with both energy dependences consistent with previous analyses of nucleon scattering from 1p shell nuclei. (12 figures, 2 tables) (auth)

1309 NUCLEAR REACTIONS WITH RESONANT-PARTICLE PRODUCTION. Robson, D. (Florida State Univ., Tallahassee). Nucl. Phys.; A204: No. 3, 523-528(1973).

The observation of resonant-state products in nuclear reactions by measurements of coincidences between decay partners is proposed as a general spectroscopic tool for nuclear physics. The importance of the kinematic confinement of final-state resonant systems to a cone in the laboratory system is discussed and applied to various resonant particles. Several nuclear reactions leading to such resonant particles as final-state products are suggested, and a brief discussion of the general nature of resonant-particle spectroscopic studies is presented. (1 table) (auth)

Nuclear Properties and Reactions, 20 ≤ A ≤ 38

Refer also to abstracts 1131, 1294, 1304, 1306, 1307, 1323, 1339, 1347, 1349, and 1424.

1310 (NP-19660) ANNUAL REPORT, 1971. (Paris Univ., Orsay (France). Institut de Physique Nucleaire). 1971. 220p. (In French). Dep. NTIS (U. S. Sales Only).

Research in the nuclear physics, high-energy physics, radiochemistry, and theoretical physics divisions is reported, along with general technical research. Most of the items are very brief, some of them less than half a page in length. Publications, seminars, and theses of various members are included. (RWR)

1311 (ORNL-TM-4204) REPORT TO THE U. S. NUCLEAR DATA COMMITTEE. Perey, F. G. (Oak Ridge National Lab., Tenn.). Apr. 1973. Contract W-7405-eng-26. 33p. Dep. NTIS $3.75.

This memo is a collection of brief reports on recent and not yet generally publicized work at ORNL that is of special interest to the USNDC. Included are abstracts of relevant ORNL reports and papers that have been only submitted for publication. The memo covers the period of time since the last USNDC meeting. (1 table) (auth)

1312 PHOTOPRODUCTION OF ^{18}F FROM ^{27}Al AT ENERGIES BETWEEN 0.3 AND 1 GeV. Di Napoli, V. (Univ., Rome); Lacerenza, A. M.; Salvetti, F.; Terenzi, S. M.; de Carvalho, H. G.; Martins, J. B. J. Inorg. Nucl. Chem.; 35: No. 5, 1419-1427(May 1973).

Aluminium targets have been irradiated with bremsstrahlung beams at energies between 0.3 GeV and 1 GeV, and the cross-sections of the photoproduction of ^{18}F have been measured by activation analysis. (auth)

1313 SHELL MODEL CALCULATIONS ON THE POSITIVE PARITY STATES IN ^{20}Ne. Irvine, J. M. (Univ. of Manchester, Eng.); Mani, G. S.; Pucknell, V.; Watt, A.; Whitehead, R. R. Phys. Lett.; 44B: No. 1, 16-18(2 Apr 1973).

The results of an extended shell model calculation in the space spanned by the $0p_{\frac{1}{2}}$ orbital and the whole of the sd-shell for the nucleus ^{20}Ne are presented. The positions of the (4p−0h), (6p − 2h) and (8p − 4h) bands are located and the results are compared with recent experiments. (auth)

1314 MEASUREMENT AND EVALUATION OF POLARIZING POWER OF SOME NUCLEI IN ELASTIC SCATTERING OF NEUTRONS. Haensgen, H.; Nitzsche, M. (Technical Univ., Dresden). Kernenergie; 15: No. 7, 234-238(Jul 1972). (In German).

The polarization angular distributions of 2.84- and 2.91-MeV neutrons elastically scattered from ^{24}Mg and ^{52}Cr were measured and analyzed on the basis of optical model. A set of parameters can be found which reproduce very well both the polarizing power and the differential elastic cross sections of the two nuclei and, simultaneously, are close to Becker's set of parameters. The experiments show that the Rosen potential is very well suited to describe proton experiments, but that neutron experiments may

better be described by Becker's potential. (5 figures, 1 table) (auth)

1315 STUDY OF ^{36}Al AND ^{36}Cl WITH THE (p,d) REACTION. Kroon, J. (Univ. of Ottawa, Ont.); Hird, B.; Ball, G. C. Nucl. Phys.; A204: No. 3, 609-624(1973).

Angular distributions from the (p,d) reactions with ^{37}Al and ^{37}Cl were measured in order to obtain spectroscopic information for the odd-odd nuclei ^{36}Al and ^{36}Cl. Good agreement was found between experimental spectroscopic factors for T = 1 states in ^{36}Al and those calculated from a $1d_{\frac{3}{2}}-2s_{\frac{1}{2}}$ shell-model scheme. This led to the identification of the $J^{\pi} = 4^+$, T = 1 level in ^{36}Al at 4.699 MeV. The spectroscopic factors from the $2s_{\frac{1}{2}}-1d_{\frac{3}{2}}$ and $1d_{\frac{3}{2}}-2s_{\frac{1}{2}}-1d_{\frac{5}{2}}$ shell-model calculations for A = 36 nuclei are also in good agreement with experimental spectroscopic factors for ^{36}Cl. The excitation energy of the lowest $J^{\pi} = 0^+$, T = 2 level in ^{36}Cl was determined to be 4.297 ± 0.010 MeV. (7 figures, 6 tables) (auth)

Nuclear Properties and Reactions, 39 ≤ A ≤ 58

Refer also to abstracts 1131, 1295, 1307, 1311, 1314, 1328, 1334, 1339, 1347, 1349, 1397, 1406, 1424, and 1425.

1316 (BNL-17771) (^{13}C,^{12}C) REACTIONS ON $f_{\frac{7}{2}}$ SHELL TARGETS. Hansen, O.; LeVine, M. J.; Schwarzschild, A. Z.; Baltz, A. J.; Fortune, H. T.; Liotta, R. (Brookhaven National Lab., Upton, N. Y.). (nd). 7p. (CONF-730312-4). Dep. NTIS $3.00.

From symposium on heavy-ion transfer reactions; Argonne, Illinois, USA (15 Mar 1973).

The (^{13}C,^{12}C) one-neutron-transfer reactions on targets of ^{40}Ca, ^{50,52}Cr, and ^{54}Fe have been investigated at bombarding energies from 40 to 48 MeV. The results from ^{40}Ca and ^{54}Fe are reported, together with a finite-range DWBA analysis. Good agreement between the DWBA predictions and the data was obtained for the post representation without recoil corrections and for both post and prior representations when the approximate recoil corrections were included. Spectroscopic factors for several states are established. (3 figures, 1 table) (RWR)

1317 (BNL-17780) FORWARD PEAKING IN THE ONE NUCLEON TRANSFER REACTION ^{48}Ca(^{14}N,^{13}C)^{49}Sc. Schneider, M. J.; Chasman, C.; Auerbach, E. H.; Kahana, S. (Brookhaven National Lab., Upton, N. Y.). (nd). 7p. (CONF-730312-5). Dep. NTIS $3.00.

From symposium on heavy-ion transfer reactions; Argonne, Illinois, USA (15 Mar 1973).

The (^{14}N,^{13}C) reaction on ^{48}Ca was studied at 50 MeV, and the results were compared with published data on other proton stripping reactions on ^{48}Ca. All known ^{49}Sc levels below 5.6 MeV excitation were resolved. Strong levels appeared throughout the ^{49}Sc spectrum, and raw relative level strengths were surprisingly similar to those for (^{3}He,d) reactions. Several angular distributions showed peaks at forward angles. Both forward-peaked and normal bell-shaped angular distributions were fitted well by no-recoil DWBA calculations, which also reproduced their apparent dependence on transferred l. Optical-model parameters for the DWBA calculations were obtained from fits to measured elastic scattering of 50-MeV ^{13}C and ^{14}N by ^{48}Ca. (3 figures) (RWR)

1318 (CONF-720669-, pp 269-286) COMPOUND NUCLEUS REACTIONS FAR FROM VALLEY OF STABILITY AND THE PROBLEM OF ACHIEVING A COMPOUND NUCLEUS SITUATION IN HEAVY-ION SCATTERING. Blann, M. (Univ. of Rochester, NY). 1972.

In proceedings of heavy-ion summer study.

1319 MAGNETIC DIPOLE MOMENTS OF VERY SHORT-LIVED NUCLEAR STATES BY THE TRANSIENT-FIELD IMPLANTATION PERTURBED ANGULAR CORRELATION METHOD AND RADIATION DAMAGE STUDIES IN IRON. Hubler, G. K. Jr. Brunswick, NJ; Rutgers-The State Univ. (1972). 210p. University Microfilms Order No. 73-4755.

Thesis (Ph. D.).

A method was developed which makes possible the measurement of magnetic dipole moments of very short-lived nuclear excited states. The technique makes use of transient magnetic fields acting on fast ions as they slow down in ferromagnetic materials. The theory of Lindhart and Winther has been modified to include the effect of decays-in-flight which becomes an appreciable correction for life-times less than 10^{-11} seconds. The following g-factors have been measured: g(^{54}Fe, 1409 keV, 1.4 psec) = 1.43(0.28), g(^{56}Fe, 847 keV, 10.0 psec) = 0.60(0.10), g(^{57}Fe, 367 keV, 11.0 psec) | < 0.6, |g(^{57}Fe, 707 keV, 5.0 psec)| < 0.4, g(^{104}Pd, 554 keV, 14.0 psec) = 0.36(0.05), g(^{106}Pd, 512 keV, 18.4 psec) = 0.33(0.04), g(^{108}Pd, 434 keV, 34.4 psec) = 0.37(0.03), g(^{110}Pd, 374 keV, 66.0 psec) = 0.34 (0.02). The magnetic moment results of previous workers for nuclei in the A = 70-130 region were re-analyzed with the inclusion of the decays-in-flight correction. The ^{54}Fe and ^{56}Fe g-factors are found to fit a shell model description, while the A = 72-130 nuclei agree with a collective model description. ^{70}Ge is found to deviate from a collective model prediction. The hyperfine field of Pd in $Fe_{0.8}Co_{0.2}$ alloy was measured by the IMPAC technique to be the same as in Fe with a 9% experimental error. Data are presented on ^{56}Fe and ^{57}Fe implanted into iron and a $Fe_{0.8}Co_{0.2}$ alloy which show that the hyperfine field at iron in these backings depends upon the type of beam used for the implantation. A radiation damage model is proposed which attributes this effect to lattice defects caused by Coulomb collisions between particles in the ion beam and Fe lattice atoms. The damage is characterized by the parameter D = * of defects/ion/mg/cm^2. Defect production is found to be more severe the heavier the ion beam. The damage mechanism is found to explain differences in g-factors and hyperfine fields as measured by IMPAC and other techniques. (Diss. Abstr. Int., B)

1320 OPTICAL MODEL FOR 100 eV ELASTIC ELECTRON SCATTERING ON ARGON. Furness, J. B.; McCarthy, I. E. (Flinders Univ. of South Australia, Bedford Park). J. Phys., B (London); 6: No. 3, L42-L45(Mar 1973).

The optical model for electron scattering on atoms describes both differential and total reaction cross sections. The well known values of ionization cross sections provide a lower limit to reaction cross sections and, in the case of 100 eV electrons on argon, an upper limit to possible experimental values of differential cross sections. The present work investigates the sensitivity of the cross sections to physically reasonable assumptions about the model and shows that it can give valuable help in deciding the consistency of different measurements of entrance channel data. (auth)

1321 MEASUREMENT OF BREMSSTRAHLUNG SPECTRA PRODUCED IN IRON AND TUNGSTEN TARGETS BY 15-MeV ELECTRONS WITH ACTIVATION DETECTORS. Hirayama, H.; Nakamura, T. (Kyoto Univ.). Nucl. Sci. Eng.; 50: No. 3, 248-256(Mar 1973).

A new method of determining photon energy spectra has been developed with the activities induced by various photonuclear reactions. Test calculations by the orthonormal expansion method show that this method is applicable to the determination of the bremsstrahlung spectra above about 5 MeV when the activation rates and the cross-section data are given as error-free. The experiments were performed for iron and tungsten targets bombarded by 15-MeV electrons from a linear accelerator and the bremsstrahlung spectra obtained were in agreement with those of approximate calculation. This activation method has the advantage of being available for measuring the spectrum of a bremsstrahlung burst and being suitable for determining the distribution of the photon energy spectrum in the medium. (auth)

1322 MEASUREMENT AND EVALUATION OF TOTAL NEUTRON CROSS SECTION MINIMA IN ELEMENTAL IRON FROM 24 TO 750 keV. Alfieri, K. A.; Block, R. C.; Turinsky, P. J. (Rensselaer Polytechnic Inst., Troy, NY). Nucl. Sci. Eng.; 51: No. 1, 25-31(May 1973).

Low-resolution transmission experiments on 14- and 20-in.-thick samples of iron were conducted at Rensselaer Polytechnic Institute's linear accelerator to evaluate the adequacy of various data files in predicting total neutron cross-section minima from 24 to 750 keV. From transmission area analysis it was concluded that both the Penny-Kinney file and Version-19 file (incorporating the Columbia minima measurement) generally overestimate the total cross section in the region of minima, with the Version-19 file strongly preferred for accurate minima prediction. With the ENDF/B-III (MAT 1180) file identical to the Penny-Kinney file (except about the 24-keV minima), similar negative conclusions apply. At the approximately 24-keV minimum where resolution was sufficient to evaluate $\sigma_t(E)$, excellent agreement with ENDF/B-III (MAT 1180) was obtained. A value of $(\sigma_t)_{min}$ = 0.42 ± 0.03 b at E = 24.3 ± 0.1 keV was found. (4 figures, 1 table) (auth)

1323 MEASUREMENT OF THE EXCITATION CROSS SECTION FOR INELASTIC NEUTRON SCATTERING BY ^{32}S AND ^{48}Ti BY MEANS OF THE SUBSEQUENT GAMMA EMISSION. Nowotny, R.; Tagesen, S. Oesterr. Akad. Wiss. Math.-Naturwiss. Kl., Anz.; 108: 88-90(1971). (In German).

The method of associated particles was used to measure the cross sections for inelastic scattering of 14-MeV neutrons by sulfur and by a titanium alloy. Both gamma and alpha events were recorded. Results were presented in form of a table. (3 figures) (HBG)

1324 CORE CONFIGURATION MIXING EFFECTS IN INELASTIC ELECTRON SCATTERING ON SPHERICAL NUCLEI. Antoine, B. (CEN, Saclay, France); Gillet, V.; Normand, J. M.;

Bellicard, J. B.; Phan Xuan Ho; Sick, I. Phys. Lett.; 44B: No. 1, 55-58(2 Apr 1973).

The effects of core configuration mixing on inelastic electron scattering were studied for the first 2^+ and 3^- levels of single closed-shell nuclei such as ^{92}Mo and ^{52}Cr. The theory accounts fairly well for the octupole states where particle hole core polarization is important. This last effect is weak for the quadrupole states and the description fails totally to account for their collectivity. (auth)

1325 QUADRUPOLE MOMENTS AND COEXISTENCE IN EVEN CALCIUM NUCLEI. Towsley, C. W.; Cline, D.; Horoshko, R. N. (Univ. of Rochester, NY). Nucl. Phys.; A204: No. 3, *574-592(1973).*

The static electric quadrupole moments of the lowest 2^+ states in ^{42}Ca and ^{44}Ca were measured to be -19 ± 8 e·fm^2 and -14 ± 7 *e·fm^2, respectively. Values for B(E2; $0_1^+ \rightarrow 2_1^+$) of 412 ± 15 e^2·fm^4* and 473 ± 20 e^2·fm^4 were measured for ^{42}Ca and ^{44}Ca, respectively. The measured moments were considerably more negative than $(fp)^n$ shell-model calculations predict; however, an excellent fit was obtained when the known E2 properties of the lowest seven levels of ^{42}Ca were used to decompose these levels into $(fp)^2$ states plus a deformed band. The energy level structure, moments of inertia, and intrinsic quadrupole moments of the deformed bands in ^{40}Ca *and ^{42}Ca are nearly identical, this fact implying that the lowest* $K = 0^+$ band in ^{40}Ca is prolate in shape. Insufficient E2 data are available for a similar model fit to ^{44}Ca; however, this model gives *a plausible explanation of the known ^{44}Ca properties. (9 figures, 5* tables) (auth)

1326 *1f2p NUCLEI: STRUCTURE OF ^{53}Cr WITH EMPHASIS* ON HIGH-SPIN STATES. Gullholmer, W.; Sawa, Z. P. (Research Inst. for Physics, Stockholm). Nucl. Phys.; A204: No. 3, *561-573(1973).*

The decay properties of high-spin states of ^{53}Cr were investigated by means of the ^{50}Ti(α, n)^{53}Cr*(γ) reaction at E_α = 10.2 to 14.2 MeV. From measurements of the yields, angular distributions, and linear polarizations of γ-ray transitions the following states were assigned: 1006 keV, $5/2^-$; *1290 keV, $7/2^-$; 1536 keV, $7/2^-$* (all confirmed); 2173 keV, $11/2^-$; 2233 keV, $9/2^{(-)}$; 2827 keV, $11/2^{(-)}$; 3084 keV, $15/2^-$; and 3593 keV, $13/2^{(-)}$. Multipole mixing ratios are *given for transitions. Coexistence of the spherical and the de-*formed states in ^{53}Cr is suggested. (5 figures, 1 table) (auth)

1327 β-DECAY OF ^{47}V. Fifield, L. K.; Noe, J. W.; Balamuth, D. P.; Zurmuehle, R. W. (Univ. of Pennsylvania, Philadelphia). Nucl. Phys.; A204: No. 3, 516-522(1973).

The γ rays emitted following the β decay of ^{47}V were studied with a 65-cm^3 Ge(Li) detector. Direct β branches were observed to the following levels in ^{47}Ti (log-ft values in parentheses): ground state *(4.9); 1550 keV (6.0); 1794 keV (5.1); 2163 keV (5.3); 2167 keV (6.2);* 2526 keV (5.4); 2549 keV (5.7); 2793 keV (5.0). The branches to the last four levels have not been reported previously. In addition, a *new γ-decay branch, 2163 → 160 keV, was observed. These results,* together with information from reaction studies, permit the assignment of spin and parity $3/2^-$ to the 2163 keV level and $5/2^-$ to the 2167 keV level. The half-life of the ^{47}V decay was measured to be 32.6 ± 0.3 min. (2 figures, 1 table) (auth)

Nuclear Properties and Reactions, 59 ≤ A ≤ 89

Refer also to abstracts 1131, 1307, 1318, 1338, 1339, 1346, 1347, 1349, and 1351.

1328 (BNL-17787) ^{18}O INDUCED REACTIONS ON EVEN Ni ISOTOPES. Auerbach, E. H.; Baltz, A. J.; Bond, P. D.; Chasman, *C.; Garrett, J. D.; Jones, K. W.; Kahana, S.; LeVine, M. J.;* Schneider, M.; Schwarzschild, A. Z.; Thorn, C. E. (Brookhaven National Lab., Upton, NY). 1973. 10p. (CONF-730312-6). Dep. NTIS $3.00.

From symposium on heavy-ion transfer reactions; Argonne, Illinois, USA (15 Mar 1973).

Experimental evidence is presented for significant deviations from the characteristic shape in the angular distributions of the ^{58,60}Ni(^{18}O,^{16}O) transitions for the ground and first excited states of ^{60,62}Ni at incident energies from 50 to 65 MeV. These cross sections are peaked towards the most forward angles observed. On the other hand, the angular distributions for the ^{62,64}Ni(^{18}O,^{16}O) and the Ni(^{18}O,^{19}F)Co reactions more closely resemble the bell-shaped curves expected from classical considerations and seen in earlier work. The anomalous ^{58,60}Ni(^{18}O,^{16}O) and normal ^{62,64}Ni-(^{18}O,^{16}O) angular distributions persist over a range of incident energy. The data were analyzed by the DWBA method. The key to the theoretical analysis of the (^{18}O,^{16}O) reaction was the reduction of absorption in the surface region of the ^{58,60}Ni heavy-ion optical potentials. In order for the changes in cross section observed between ^{58}Ni and ^{64}Ni to be achieved smoothly, it is important to hold the absorption at a critically weak level. Only then can slight alterations in depths and radii turn the normal angular distribution for the ^{62,64}Ni(^{18}O,^{16}O) reaction into the forward-peaked distribution for the ^{58,60}Ni targets. Apart from the apparent strong oscillations, a reasonable fit to the shape of the ^{62,64}Ni(^{18}O,^{16}O) angular distributions was obtained for 65 MeV. (4 figures, 1 table) *(RWR)*

1329 (JINR-P1-6897) TOTAL DISINTEGRATION OF Ag *AND Br NUCLEI INDUCED BY 10 AND 70 GeV/c PROTONS.* Tolstov, K. D.; Khoshmukhamedov, R. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 20p. (In *Russian). Dep. NTIS (U. S. Sales Only) $3.00.*

The total disintegration of Ag and Br nuclei, induced by protons with momenta of 9.6 and 69 GeV/c, is studied. It is shown that disintegration without a residual nucleus, and mainly into separate nucleons, takes place. Distributions of secondary particles over *charges, energy, and emission angles are obtained. A comparison* is made with models for the interaction of fast particles with nuclei. (7 figures, 2 tables) (auth)

1330 SPECTROSCOPY OF ^{67}Zn VIA ANALOG RESONANCES IN ^{66}Zn(p,p'γ). Sinclair, J. W. D. Columbus, OH; Ohio State Univ. *(1972). 118p. University Microfilms Order No. 73-2126.*

Thesis (Ph. D.).

Resonant states in the ^{66}Zn + p and ^{70}Zn + p compound systems *have been investigated. Isobaric analogs of some low-lying states* in ^{67}Zn have been studied using the triple angular correlation geometry of Goldfarb and Seyler for the ^{66}Zn(p,p'$_1\gamma$)^{66}Zn* (1.04 MeV) reaction. *The following spin and parity assignments are made or* confirmed for the indicated states in ^{67}Zn: (energy in MeV) 0.390, $3/2^-$; 0.978, $5/2^+$; 1.444, $(3/2^-)$; 1.542, $(3/2)^-$; 1.676, $(1/2)^+$; 2.273, $5/2^+$; 2.407, $5/2^+$; 2.609, $(5/2)^+$; and 2.797, $5/2^+$. In the course of these studies, excitation functions for protons elastically scattered to *the 0^+ ground state of ^{66}Zn were measured at laboratory angles* of 90° and 130° for incident beam energies from 3.0 to 5.8 MeV. These curves were fit to obtain l-values for resonances in the *compound system. Excitation functions for protons inelastically* scattered to the 2^+, 1.04 MeV state of ^{66}Zn were also obtained for the above angles and energy range. Excitation functions for pro*tons elastically scattered to the (0^+) ground state of ^{70}Zn were* measured at laboratory angles of 125° and 165° over the same energy range. (Diss. Abstr. Int., B)

1331 DETERMINATION OF (γ,n) AND (γ,2n) CROSS SECTIONS IN ^{70}Ge, ^{72}Ge, ^{74}Ge, AND ^{76}Ge. Vander Molen, H. J. *Ames, IA; Iowa State Univ. (1972). 102p. University Micro-*films Order No. 73-9496.

Thesis (Ph. D.).

Cross sections for the (γ,n) and (γ,2n) reactions of ^{70}Ge, ^{72}Ge, ^{74}Ge, ^{76}Ge were measured from threshold to 40 MeV. One-gram separated isotope targets of the four nuclides were bombarded with bremsstrahlung from the Iowa State University 70-MeV electron synchrotron. The photoneutrons emitted during bom*bardment were counted by a high-efficiency 4π neutron-sensitive* scintillation detector. The neutron multiplicities were separated by an on-line event-by-event recording system. Reaction yields *were obtained at bremsstrahlung end-point energies between 10* and 40 MeV at 2 MeV intervals, and cross sections were extracted from the resulting yield curves. Resonances were ob*served at about 17 MeV in the (γ,n) reactions, and at about 26* MeV in the (γ,2n) reaction, for all four nuclides. In addition, a secondary resonance in the (γ,n) reaction was observed at 35 MeV in ^{70}Ge, 34 MeV in ^{72}Ge, 31 MeV in ^{74}Ge, and 25 MeV in ^{76}Ge. (Diss. Abstr. Int., B)

1332 PROTON ENHANCEMENT INDUCED BY ISOSPIN CONSERVATION IN THE LOW ENERGY CONTINUUM: p + ^{62}Ni, α + ^{59}Co. Jaffe, G. M. New York; Columbia Univ. (1972). 121p. University Microfilms Order No. 73-9025.

Thesis (Ph. D.).

Energy spectra measurements of emitted protons and alpha particles from the ^{63}Cu compound system excited to 18.06 MeV, formed from the reactions of protons with ^{62}Ni and alpha particles with ^{59}Co, indicate an apparent nonconformity to the Bohr Independence Hypothesis at the low-energy portion of the continuum. *Protons emitted with energies above 4.6 MeV from the p + ^{62}Ni* entrance channel exhibit spectral features inconsistent with a compound-nucleus mechanism. The observed apparent violation of the Independence Hypothesis could not be explained by consideration of the angular-momentum disparities in the two entrance channels. The enhancement of low-energy protons, responsible for the apparent violation, could in fact be understood

in the light of isotopic spin conservation. Inclusion of isospin theory in the angular-momentum-dependent statistical model is quantitatively in agreement with experimental measurements, and is consistent with an isospin purity of 50 per cent. (Diss. Abstr. Int., B)

1333 MEASUREMENT OF SEVERAL (n,p), (n,2n), AND (n,nγ) EXCITATION CROSS SECTIONS FOR MEDIUM-HEAVY NUCLEI. Wagner, L.; Uhl, M. Oesterr. Akad. Wiss. Math. Naturwiss. Kl., Anz.; 108: 185-188(1971). (In German).

By means of the activation method, the cross sections were measured for several (n,p), (n,2n), and (n,n'γ) reactions in ^{69}Ga, ^{71}Ga, ^{75}As, ^{107}Ag, and ^{109}Ag. The neutron energy was 14.7 MeV. The gamma spectra were registered by a Ge(Li) detector. Results were compiled in form of a table. (1 table) (HBG)

1334 INTERPRETATION OF (n,n'γ) CROSS SECTIONS FOR FAST NEUTRONS IN THE FRAMEWORK OF THE STATISTICAL MODEL FOR NUCLEAR REACTIONS. Uhl, M. (Institut fuer Radiumforschung und Kernphysik, Vienna). Oesterr. Akad. Wiss. Math.-Naturwiss. Kl., Anz.; 108: 8-19(1971). (In German).

For a large number of (n,n'γ) reactions, the report compares the experimental cross sections with those derived from statistical models. The agreement between experiment and calculation is surprisingly good. The cross sections for the $2^+ \rightarrow 0^+$ transition are furnished correctly by the statistical model. (4 figures) (HBG)

1335 DELAYED-NEUTRONS FROM ARSENIC ISOTOPES ^{84}As, ^{85}As, AND ^{86}As. Kratz, J. V.; Franz, H.; Herrmann, G. (Univ., Mainz). J. Inorg. Nucl. Chem; 35: No. 5, 1407-1417 (May 1973).

Short-lived arsenic isotopes were produced by thermal-neutron fission of ^{235}U and isolated within 2.5 sec by volatilization of arsenic hydride. The existence of a strong delayed-neutron precursor of 2.05 ± 0.05 sec half-life among the arsenic isotopes is confirmed; and its assignment to ^{85}As, ascertained by milking of the daughter product, 33-sec ^{85}Se, and of 3.1-min ^{84}Se, which is the final nucleus in the neutron decay branch of ^{85}As. A delayed-neutron yield of 7.8 ± 1.2 neutrons/10^4 fissions was obtained for ^{85}As. A new isotope, 0.9 ± 0.2 sec ^{86}As, was detected by delayed-neutron counting and by following the decay of its most prominent γ-ray. The mass assignment was verified by milking of 54-sec ^{86}Br. The delayed-neutron yield of ^{86}As amounts to 0.57 (+0.25/–0.15) neutrons/10^4 fissions. Neutron emission was also detected in the decay of the 5.5-sec ^{84}As, with a yield of 0.02 ± 0.01 neutrons/10^4 fissions. By using the measured delayed-neutron yields and measured or estimated fission yields, the following neutron emission probabilities were obtained: P_n^{84} = 0.13 ± 0.06%, P_n^{85} = 23 ± 3% and P_n^{86} = 3.8(+1.7/–1.0)%. From the growth of ^{87}Br in arsenic samples a half-life of about 0.3 sec and a fractional cumulative yield of 1.8 ± 0.9% were deduced for ^{87}As. (auth)

1336 ANOMALOUS MOMENTS OF INERTIA FOR HIGH-SPIN LEVELS IN THE BETA VIBRATIONAL BAND OF ^{154}Gd. Ward, D.; Graham, R. L.; Geiger, J. S.; Andrews, H. R. (Chalk River Nuclear Labs., Ont.). Phys. Lett.; 44B: No. 1, 39-40 (2 Apr 1973).

The levels of ^{154}Gd populated by the ^{154}Sm(α,4n) reaction were studied with γ–γ coincidence techniques. The energy spacings of the β-band levels of spin >8 are found to differ from the rotational picture in a manner similar to that recently observed in the ground-state bands of some other rare-earth nuclei. The ground-state band of ^{154}Gd does not show the anomaly. (auth)

Nuclear Properties and Reactions, 90 ≤ A ≤ 149

Refer also to abstracts 482, 486, 506, 1131, 1307, 1318, 1324, 1329, 1333, 1359, 1397, and 1405.

1337 (BNL–17770) STUDY OF THE SINGLE NEUTRON TRANSFER REACTIONS ^{94,96}Mo(^{13}C,^{12}C)^{95,97}Mo. Bond, P. D.; Chasman, C.; LeVine, M. J.; Schwarzschild, A. Z.; Thorn, C. E.; Baltz, A. J. Brookhaven National Lab., Upton, N. Y.). [nd]. 8p. (CONF-730312–3). Dep. NTIS $3.00.

From symposium on heavy-ion transfer reactions; Argonne, Illinois, USA (15 Mar 1973).

The ^{94,96}Mo(^{13}C,^{12}C)^{95,97}Mo reactions were studied at 48.5 to 54.5 MeV. Particle identification was done by standard ΔE–E telescopes. Particle–gamma coincidence measurements with a Ge(Li) detector were used to obtain cross sections to individual excited states. Optical-model fits are shown to elastic scattering angular distributions at 51 MeV for ^{94}Mo and 54.5 MeV for ^{96}Mo; DWBA calculations are illustrated for reaction differential cross sections in the same incident channels. Gamma-ray coincidence spectra are shown for both reactions for an incident energy of 48.5 MeV. The DWBA calculations seem to explain the observed selectivity of these transfer reactions in both ^{95}Mo and ^{97}Mo. Also, it appears that two-step processes do not have a large effect on the magnitudes of the cross section in the Mo isotopes. (2 figures, 1 table) (RWR)

1338 (CEA-CONF-2185) RECENT RESULTS OBTAINED IN THE STUDY OF THE GIANT DIPOLE RESONANCE WITH MONOCHROMATIC PHOTONS AT THE SACLAY 65-MeV LINAC. Bergere, R.; Beil, H.; Carlos, P.; Lepretre, A.; Veyssiere, A. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1971. 36p. (CONF-710976-1). Dep. NTIS (U. S. Sales Only) $4.00.

From conference on report of electron accelerator working group; Giessen, Federal Republic of Germany (23 Sep 1971).

Several pieces of work on (γ,xn) reactions are described. The photons were produced by in-flight annihilation of positrons. (I) Photoneutron cross sections are presented for the (γ,n) + (γ,2n) + (γ,pn) reactions with Ba, ^{139}La, Ce, ^{141}Pr, and Nd at 9 to 18 MeV. Lorentz line parameters are tabulated. (II) The evolution of the giant dipole resonance from ^{142}Nd (N = 82) to ^{150}Nd (N = 90) was studied. Cross sections for (γ,2n) and (γ,n) + (γ,2n) + (γ,pn) reactions are shown from 9 to 20 MeV. Lorentz line parameters specifying the best fits to the latter are tabulated. The results (in particular, the evolution of the shape of the cross section curves) for ^{142}Nd to ^{148}Nd show the behavior predicted by the dynamic collective model when a coupling between dipole oscillations and surface vibrations is taken into account. On the other hand, the structure observed between 9 and 13 MeV in ^{150}Nd cannot be explained by this theory. (III) The photoneutron cross sections for Rb, Sr, ^{89}Y, ^{90}Zr, and ^{93}Nb are plotted, together with their representations by a one-Lorentz line obtained by fitting the experimental cross sections in the energy range from 14 to 18 MeV; the corresponding parameters are tabulated. A mathematical representation of the experimental data, such as a one-Lorentz line fit, cannot account for the observed structure in the rising part of the giant dipole resonance; for E > 18 MeV the high-energy tail of the Lorentz curve lies below the measured photoneutron absorption points; for E > 22 MeV the dipole absorption part leading to a two-neutron emission is well represented by the extrapolation of the Lorentz curve to these energies. The results for Sr and ^{90}Zr are compared with data from (p,γ) and (e,e'p) reactions. Values calculated from σ_{-1} sum rules are tabulated. (IV) Classical sum rules for σ_0, σ_{-1}, and σ_{-2} are discussed and evaluated with available experimental data. (V) Cross sections for (γ,xn) reactions with ^{208}Pb (x = 1, 2, 3, 4) are shown up to 38 MeV, and Lorentz line fits are made for the first two. The mechanism for these reactions is discussed, and the "precompound model" shows some agreement with the data. (14 figures, 4 tables) (RWR)

1339 (CEA-N-1598) Q-VALUE TABLE FOR HEAVY IONS. Delaunay, J. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Feb 1973. 83p. (In French). Dep. NTIS (U. S. Sales Only) $6.25.

A program to determine the reaction Q-values for stable targets with heavy ion beams was written; values determined using this program are tabulated for the most-used beams. (RWR)

1340 (CEA-R-4427) ACCURATE MEASUREMENT OF SOME INTERNAL CONVERSION COEFFICIENTS (^{109}Ag: 88 keV, ^{99}Tc: 140 keV, ^{139}La: 166 keV, AND ^{135}Ba: 268 keV). Legrand, J.; Blondel, M.; Magnier, P.; Perrot, C.; Brethon, J. P. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Feb 1973. 30p. (In French). Dep. NTIS (U. S. Sales Only) $3.50.

The coefficients of internal conversion for some γ transitions were accurately measured. Most of them (^{109}Ag, ^{139}La, ^{99}Tc) were determined by combining the measurement of electron conversion using a high pressure 4π proportional counter with the measurement of γ photons using a well-type NaI (Tl) scintillator. The following results were obtained: ^{99m}Tc, α_t = 0.118 ± 0.003; ^{109m}Ag, α_t = 25.4 ± 0.5; ^{139}La, α_t = 0.2446 ± 0.0012; ^{135m}Ba, α_t = 5.42 ± 0.11. (9 figures, 6 tables) (auth)

1341 (CONF-720669-) PROCEEDINGS OF HEAVY-ION SUMMER STUDY, OAK RIDGE NATIONAL LABORATORY, June 12–July 1, 1972. Thornton, S. T. (ed.) (Oak Ridge National Lab., Tenn.). 1972. 644p. Dep. NTIS $9.00.

Thirty-five papers are presented which were prepared from the oral proceedings of the symposium. Two-thirds of the papers emphasize heavy-ion nuclear physics and chemistry while the remaining third covers atomic, solid state, and biological physics. (WDM)

For titles of individual papers see: 670, 1092–1096, 1109, 1293–1297, 1318, 1342–1345, 1358, 1370–1372, 1376–1381, 1390–1396, and 1503.

1342 (CONF-720669-, pp 163-197) EXPERIMENTAL SITUATION OF NUCLEON TRANSFER BETWEEN HEAVY IONS AND THE ELASTIC AND INELASTIC SCATTERING OF HEAVY IONS. Becchetti, F. D. (Univ. of California, Berkeley). 1972.

In proceedings of heavy-ion summer study.

1343 (CONF-720669-, pp 220-232) NUCLEAR PROPERTIES FAR FROM STABILITY. Hansen, P. G. (CERN, Geneva). 1972.

In Proceedings of Heavy-Ion Summer Study.

1344 (CONF-720669-, pp 378-405) MEASUREMENT OF HIGH SPIN STATES OF NUCLEI PRODUCED BY HEAVY-ION REACTIONS. Sunyar, A. W. (Brookhaven National Lab., Upton, NY). 1972.

In Proceedings of Heavy-Ion Summer Study.

1345 (CONF-720669-, pp 465-473) THEORY OF COULOMB IONIZATION OF ATOMS BY FAST HEAVY IONS. Merzbacher, E. (Univ. of North Carolina, Chapel Hill). 1972.

In Proceedings of Heavy-Ion Summer Study.

1346 (HEDL-TME-73-30) NEUTRON RESONANCE SPACINGS FOR SPHERICAL NUCLEI. Schmittroth, F. (Hanford Engineering Development Lab., Richland, Wash.). Jan 1973. Contract AT(45-1)-2170. 60p. Dep. NTIS $5.45.

Theoretical single-particle level densities are computed for a Woods-Saxon potential to estimate average neutron-resonance spacings for spherical nuclei. This average spacing, D_{obs}, is a key parameter for neutron-capture calculations. Experimental values for D_{obs}, which are evaluated for about 85 nuclei using recent data, are used to improve the theoretical estimates. Special care is given to the identification of p-wave resonance in these evaluations. (8 figures, 3 tables) (auth)

1347 (INDC(HUN)-10) COMPILATION OF (n,2n) CROSS SECTIONS MEASURED AT ABOUT 14 MeV FOR NUCLIDES 6 < Z < 93. Boedy, Z. T. (International Nuclear Data Committee). Jan 1973. 129p. Dep. NTIS (U. S. Sales Only) $8.50.

A compilation of 14-MeV (n,2n) cross sections is given. Most of the measurements were done by activation methods. The closing date of the compilation is nominally January, 1972. This compilation formed the basis for an evaluation of recommended values of (n,2n) cross sections at 14.7 MeV. Although this evaluation has been published, a preprint is included in this document. (128 references) (RWR)

1348 (ORO-2434-9) EXPERIMENTAL STUDY OF NUCLEAR MODELS. I. Decay Schemes and Nuclear Reactions. II. Muonic X-ray Studies. Progress Report, August 1, 1972-July 31, 1973. Sheline, R. K. (Florida State Univ., Tallahassee). 1973. Contract AT(40-1)-2434. 36p. Dep. NTIS $4.00.

Progress is summarized for the contract year from August 1, 1972, through July 31, 1973. In the study of nuclear models the levels in ^{138}La and in nuclei in the vicinity of ^{210}Bi were compared with levels predicted from the appropriate configurations of the shell model. The structure and spectroscopy of transitional nuclei were also considered-- in particular, the neutron-excess Ru and Pd, the neutron deficient Ba, and the neutron-deficient Rn, Ra, and Th nuclei. Evidence is presented for stable octupole deformation in the nuclei beyond ^{208}Pb. The deformed nuclei ^{176}Hf, ^{180}Hf, ^{188}W, and ^{188}Re are analyzed from the point of view of the Nilsson model. Theoretical research on shell structure for deformed nuclear shapes, the A-dependence of the critical spin in nuclei, and the synthesis of superheavy elements in nature is presented. The study of the isotopic substitution and nuclear moments in metal carbonyls is described briefly. Finally, a discussion of progress in the preparation for studying muonic x-rays at LAMPF in collaboration with LASL is presented. (auth)

1349 (UCRL-74622) ATLAS OF PHOTONEUTRON CROSS SECTIONS OBTAINED WITH MONOENERGETIC PHOTONS. Berman, B. L. (comp.) (California Univ., Livermore. Lawrence Livermore Lab). 1973. 85p. (CONF-730301-4). Dep. NTIS $6.25.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

Photoneutron cross-section data obtained with monoenergetic photons from positron annihilation in flight are presented in a uniform format. This compilation is current as of early 1973. (72 figures) (auth)

1350 ^{96}Mo(p,n)^{96m,g}Tc REACTION FROM 10 TO 65 MeV. Hogan, J. J. (McGill Univ., Montreal). J. Inorg. Nucl. Chem.; 35: No. 5, 1429-1433(May 1973).

The production cross sections and isomer ratios of the 4+ and 7+ states of ^{96}Tc produced from 10 to 65 MeV proton bombardment of ^{96}Mo have been measured. Results show an enormous variation--nearly three orders of magnitude--in the ratio σ_m/σ_g. In the compound nucleus mechanism region, the results are explainable in terms of the unusually large spins of both isomers. To date, the (p,n) results arising in the bombarding energy region where direct mechanisms predominate are unexplained. (auth)

1351 DECAY ENERGIES OF GASEOUS FISSION PRODUCTS AND THEIR DAUGHTERS FOR A = 88 TO 93. Clifford, J. R. Ames, IA; Iowa State Univ. (1972). 105p. University Microfilms Order No. 73-9431.

Thesis (Ph. D.).

A systematic study of beta-decay energies was made for mass-separated activities of Kr gaseous fission products and their daughters at the TRISTAN on-line separator facility at the Ames Laboratory Research Reactor. A Pilot B well-type plastic scintillator was used in coincidence with a 60-cm^3 Ge(Li) gamma detector. The following beta-decay end-point energies were determined: ^{89}Kr, 2.93 ± 0.03 MeV; ^{88}Rb, 5.30 ± 0.06 MeV; ^{89}Kr, 4.93 ± 0.06 MeV; ^{90}Kr, 4.35 ± 0.05 MeV; ^{90}Rb, 6.32 ± 0.06 MeV; ^{91}Kr, 6.12 ± 0.07 MeV; ^{91}Rb, 5.68 ± 0.04 MeV; ^{92}Kr, 5.97 ± 0.08 MeV; ^{92}Rb, 7.58 ± 0.15 MeV; ^{92}Sr, 1.93 ± 0.03 MeV; ^{93}Kr, 8.3 ± 0.5 MeV; and ^{93}Rb, 7.23 ± 0.10 MeV. The decay energies were compared with previous measurements, systematics predictions, and two currently accepted mass relations. The energies were used to predict the beta-decay energies for thirteen additional nuclei by means of systematics. (Diss. Abstr. Int., B)

1352 ^{91}Zr(τ,α)^{90}Zr AND THE T = 1 $g_{9/2}$-$d_{5/2}$ MATRIX ELEMENTS: TEST OF AN AVERAGE EFFECTIVE INTERACTION. Fann, H.; Schiffer, J. P.; Strohbusch, U. (Argonne National Lab., IL). Phys. Lett.; 44B: No. 1, 19-22(2 Apr 1973).

The ^{91}Zr(τ,α)^{90}Zr reaction was studied and members of the $(g_{9/2})^{-1}d_{5/2}$ multiplet were identified, yielding the $g_{9/2}$-$d_{5/2}$ particle-particle matrix elements in both isospin states. The results are compared with calculations using an interaction that had been deduced from other data. (auth)

1353 ATOMIC AND NUCLEAR PHYSICS. Yarwood, J. London; University Tutorial Press Ltd. (1973). 608p.

The subject is dealt with in chapters: positive ray analysis, mass spectrometers and stable isotopes; the spectrum of the hydrogen atom and of an ion with a single orbital electron; atomic spectra and the periodic classification of the elements; the critical potentials of atoms; X-rays and X-ray spectra; the principles of quantum mechanics; atomic magnetism; natural radioactivity; general properties of the radiations from radioactive nuclides; the bombardment of nuclei by alpha-particles--induced radioactivity; the acceleration of particles to high energies; the bombardment of nuclei by artifically accelerated particles; the interactions of neutrons with matter; the detection of nuclear radiations; the structure of nuclei--the theory of nuclear radiations; further aspects of nuclear reactions--nuclear magnetism; fission and fusion of nuclei--nuclear energy; cosmic rays--elementary particles. Appendices include: the variation of mass with velocity--the equivalence of mass and energy; notes on methods of separating isotopes; some important radioactive nuclides--their half-life, type of radiation, and energy of radiation in MeV. (UK)

1354 Ge(Li)-Ge(Li) COINCIDENCE STUDIES IN ^{147}Pm. Singh, R.; Mehta, G. K. (Indian Inst. of Tech., Kanpur). Indian J. Pure Appl. Phys.; 10: No. 10, 733-736(Oct 1972).

The decay scheme of ^{147}Pm was investigated with Ge(Li)-Ge(Li) fast-slow coincidence measurements. Besides the well-established levels at 91, 410.5, 489.9, 531, and 685.8 keV, the levels at 182, 228.5, 275, 319.5, 680, and 725 keV were confirmed from coincidence studies. No evidence was found for excited states at 120.5, 211.5, 398.9, 471, 552, and 763 keV or the transitions 725-0, 725-182, 658.8-182, 489.9-410.5, and 489.9-319.5 keV. (8 figures, 1 table) (auth)

1355 VARIATIONAL PRINCIPLE FOR CRITICAL CHARGE. Perelomov, A. M.; Popov, V. S. Teor. Mat. Fiz.; 14: No. 1, 18-26(Jan 1973). (In Russian).

Method of the effective potential is developed and variational principle is formulated for determining the critical charge. (auth)

1356 NUCLEAR ORIENTATION STUDY OF THE EXCITED STATES OF ^{129}I POPULATED IN THE DECAY OF ^{129g}Te AND ^{129m}Te. Silverans, R. E.; Schoeters, E.; Vanneste, L. (Leuven Univ., Heverlee, Belgium). Nucl. Phys.; A204: No. 3, 625-635 (1973).

From the angular distributions of γ rays emitted by oriented ^{129g}Te and ^{129m}Te nuclei implanted in iron by isotope separator, unique spin assignments could be made for the excited states of ^{129}I at 487.4 keV ($5/2^+$), 696.0 keV ($11/2^+$), 729.6 keV ($5/2^+$), 768.9 keV ($7/2^+$), 1050.4 keV ($7/2^+$), and 1111.8 keV ($5/2^+$). In addition, E2/M1 amplitude ratios for the following ^{129}I γ rays (energies are in keV) were derived: $\delta(459.6) = -(0.076^{+0.037}_{-0.040})$; $\delta(487.4) = 0.50^{+0.17}_{-0.10}$ or $\delta^{-1} =$

$0.35^{+0.15}_{-0.09}$; $\delta(556.7) = 0.06 \pm 0.02$ or $\delta^{-1} = -(0.10 \pm 0.02)$; $\delta(624.4) = 0.10 \pm 0.26$ or $\delta^{-1} > 0.4$; the 696.0-keV γ ray is pure E2; $\delta(729.6) = -(0.34 \pm 0.06)$ or $\delta^{-1} = 0.55 \pm 0.05$; $\delta(741.1) = -(0.27 \pm 0.10)$ or $\delta^{-1} = -(0.43 \pm 0.12)$; $\delta(817.2) = 0.46 \pm 0.04$ or $\delta^{-1} = 0.20 \pm 0.03$ if I^{π} (845 keV) = $^7/_2^+$; $\delta(1022.6) = -(0.02 \pm 0.02)$ or $\delta^{-1} = -(0.23 \pm 0.02)$; $\delta(1084) = 0.56^{+0.13}_{-0.11}$; $\delta(1111.8) = 0.06 \pm 0.05$ or $\delta^{-1} = -(0.08 \pm 0.05)$. The anisotropy of the 531.8-keV γ ray excludes $^1/_2^+$ as a possible spin assignment for the 559.6-keV level, so that no $^1/_2^+$ level is fed in the decay from ^{129}Te. Anisotropies for the 209-, 250.7-, 278.4-, and 281.1-keV γ rays were also measured. Comparison of the level scheme is made with theoretical predictions from both the pairing plus-quadrupole model and the intermediate-coupling unified model. (8 figures, 1 table) (auth)

Nuclear Properties and Reactions, 150 ≤ A ≤ 189

Refer also to abstracts 425, 486, 1131, 1321, 1339, and 1347–1349.

1357 (AECL-4428) PHYSICS DIVISION PROGRESS REPORT, OCTOBER 1–DECEMBER 31, 1972. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Mar 1973. 82p. (PR-P-96). Dep. NTIS (U. S. Sales Only) $6.25. AECL $2.00.

Work in the following areas is reviewed: operation and experimental facilities at the MP Tandem; experimental nuclear physics research; solid state studies; solid-state detectors; theoretical physics; applied mathematics and computation. As this is a quarterly report, most of the items included are short and of a transient nature. (RWR)

1358 (CONF-720669–, pp 198-219) ELASTIC AND ROTATIONAL INELASTIC SCATTERING. Rasmussen, J. (Yale Univ., New Haven). 1972.

In Proceedings of Heavy-Ion Summer Study.

1359 (JINR-P3-6948) SPINS OF ^{111,113}Cd, ^{157}Gd, ^{161,163}Dy NEUTRON RESONANCES. Karzhavina, E. N.; Kim Sec Su; Popov, A. B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1973. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Spins of neutron resonances of odd Cd, Gd and Dy isotopes were measured with the neutron spectrometer of the Laboratory of Neutron Physics by using the gamma-ray multiplicity method. Experimental values of the spin effect are compared with those obtained in terms of the statistical model of level density and probabilities of electromagnetic transitions according to Weisskopf. The force functions $S_0 = (2.1 \pm 0.7) \cdot 10^{-4}$ for J = 1 and $S_0 = (2.3 \pm 0.6) \cdot 10^{-4}$ for J = 2, as well as the average distances D = 13.3 ± 1.5 eV (J = 1), D = 9.5 ± 0.9 eV (J = 2) are presented for ^{157}Gd. (auth)

1360 (JINR–P4-6980) EFFECT OF THE CORIOLIS FORCE ON E1-TRANSITIONS BETWEEN ROTATIONAL BANDS. Baznat, M. I.; Pyatov, N. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The effect of the Coriolis force on E1 transitions with ΔK = 0 and 1 is considered within the framework of the nonadiabatic rotational model. Numerical calculations are performed for a number of odd-mass rare earth nuclei. (1 figure, 2 tables) (auth)

1361 (UCRL-51306) EVALUATED DATA SET FOR TANTALUM. Howerton, R. J.; MacGregor, M. H.; Perkins, S. T. (California Univ., Livermore. Lawrence Livermore Lab.). 11 Dec 1972. Contract W-7405-eng-48. 33p. Dep. NTIS. $4.00.

A description of the methods used to obtain neutron-induced reaction and gamma-ray production cross sections is presented for ^{181}Ta. (auth)

1362 NUCLEAR SCATTERING OF PLANE-POLARIZED 15.11 MeV PHOTONS FROM Bi, Au, AND Ta. Sazama, F. J. Washington, D. C.; American Univ. (1972). 98p. University Microfilms Order No. 73-4663.

Thesis (Ph. D.).

A beam of plane-polarized 15.11 MeV photons was developed by resonance fluorescence of the 1^+ state in ^{12}C with 20 MeV bremsstrahlung. The photon beam is 18 cm in diameter and is estimated to contain approximately 10^4 photons per second with a conventional polarization of 0.96. These photons are then scattered from targets of bismuth, gold, and tantalum. A measurement of the number of photons scattered parallel and perpendicular to the polarization vector in the incident 15.11 MeV beam was made and allows a determination of the relative contribution of incoherent and coherent scattering to the total scattering cross section. Expressed in terms of the ratio $\eta = (d\sigma_{\parallel}/d\Omega)/(d\sigma_{\perp}/d\Omega)$ the results are 0.019 ± 0.058 for bismuth, 0.168 ± 0.056 for gold, and 0.138 ± 0.073 for tantalum. These results are compared with predictions of the hydrodynamic (Danos–Okamoto) and dynamic collective models. (Diss. Abstr. Int., B)

1363 RARE EARTH YIELDS FROM BOMBARDMENT OF TUNGSTEN TARGETS WITH 24 GeV PROTONS. Newton, G.W.A. (Univ. of Manchester, Eng.); Robinson, V. J.; Skarestad, M.; Hemingway, J. D. J. Inorg. Nucl. Chem.; 35: No. 5, 1435-1441 (May 1973).

Cumulative and independent yields of lanthanides (^{143}Pm, ^{144}Pm, ^{145}Sm, ^{148}Eu, ^{149}Eu, ^{146}Gd, ^{148}Gd, ^{151}Gd, ^{153}Gd, ^{159}Dy, ^{168}Tm, ^{169}Yb) have been measured in tungsten targets following 24 GeV proton irradiation. A chain yield curve in this mass region was obtained by reference to a charge dispersion curve which was constructed for A = 148 by an extrapolation technique. The FWHM of this curve was about 1.8 charge units and $Z_p \sim 64.6$. The mass yield curves for different proton energies have been compared and the implications for possible reaction mechanisms considered. (auth)

1364 NUCLEAR STRUCTURE OF ^{169}Tm. Shimada, K.; Etoh, K; Nagura, S. I.; Shimamura, E.; Iwashita, T. (Tokyo Gakugei Univ.). Bull. Tokyo Gakugei Univ., Ser. 4; No. 23, 22-27(Jul 1971). (In Japanese).

The energies and the relative intensities of gamma-rays following the decay of ^{169}Yb have been measured with a Ge(Li) detector. Measurements of gamma–gamma perturbed angular correlations have been performed utilizing NaI(Tl) detectors. Two kinds of ^{169}Yb sources, polycrystalline Yb_2O_3 and Yb_2O_3 dissolved in 6N HCl, were used in these experiments. The integral attenuation of the angular correlation coefficients of the 177-keV–131-keV cascade due to the electric quadrupole interaction have been observed. The lifetime of the intermediate level is 0.32 ns. (auth)

1365 STATES IN ^{163}Ho AND ^{167}Tm POPULATED THROUGH THE (p,t) REACTION ON ^{165}Ho AND ^{169}Tm. Goles, R. W.; Warner, R. A.; McHarris, W. C.; Kelly, W. H. (Michigan State Univ., East Lansing). Phys. Lett.; 44B: No. 1, 59-61(2 Apr 1973).

The (p,t) reaction at 30 MeV on the deformed nuclei, ^{165}Ho and ^{169}Tm, strongly populates collective states in the residual nuclei. Indirect multiple-step processes evidently play an important rcle, and the reaction is a powerful tool for populating higher-lying rotational band members. (auth)

1366 EXPERIMENTAL STUDY OF ANGULAR DISTRIBUTIONS AND OPTIMUM Q VALUES IN HEAVY-ION REACTIONS. Schiffer, J. P. (Argonne National Lab., IL); Koerner, H. J.; Siemssen, R. H.; Jones, K. W.; Schwarzschild, A. Phys. Lett.; 44B: No. 1, 47-49(2 Apr 1973).

The optimum Q-values and total yields of transfer reactions from ^{16}O + ^{172}Yb were studied near the Coulomb barrier by observing ^{12}C, ^{14}C, and ^{15}N particles. These quantities are compared with simple classical expectations. Recoil effects are clearly seen. At energies below the barrier, the transfer probabilities are a function only of the distance of closest approach. (auth)

1367 ELASTIC AND INELASTIC DEUTERON SCATTERING FROM ^{152}Sm AND ^{162}Dy. Trautner, N.; Loevhoeiden, G.; Christensen, P. R. (Univ. of Copenhagen). Phys. Lett.; 44B: No. 1, 41-43(2 Apr 1973).

Angular distributions are measured for 12 MeV deuterons scattered to the 2^+ and 4^+ states in ^{152}Sm and ^{162}Dy. By including the couplings of the ground state to the low-lying excited states, it is shown that the experimental results can be explained by using optical model parameters from a spherical nucleus. Deformation amplitudes are deduced and compared to those found from inelastic α-particle scattering and from Coulomb excitation. (auth)

1368 DECAY PROPERTIES OF 3.25-MIN ^{169}Hf AND 2.05-MIN ^{167}Hf. Meijer, B. J.; de Boer, F. W. N.; Goudsmit, P. F. A. (Instituut voor Kernphysisch Onderzoek, Amsterdam). Nucl. Phys. A204: No. 3, 636-640(1973).

The decays of 3.25-min ^{169}Hf and 2.05-min ^{167}Hf were studied with high-resolution Ge(Li) and Si(Li) detectors. The total decay energy of ^{169}Hf determined from the experimental K/β^+ ratio is $3.29^{+0.05}_{-0.13}$ MeV. The allowed unhindered character of the main β branches in the decay of both isotopes allows unique Nilsson-model assignments. (auth)

1369 STRUCTURE OF THE GROUND STATE OF ^{170}Tm. Voronkov, Yu. P.; Mikhailov, V. M. (Leningrad State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 10, 2186-2189(Oct 1972). (In Russian).

The influence of residual interactions on the electrical proper-

ties of the rotational band with $K^\pi = 1^-$ was determined with data derived from the ground state of ^{170}Tm. The residual interactions lead to a mixture of configurations in the ground state of the odd–odd deformed nucleus ^{170}Tm. The value q_0 calculated was in agreement with experiment; q_0 was related to the quadrupole moments and the probability of E2 transitions within the rotational band with K = 1. (tr-auth)

Nuclear Properties and Reactions, 190 ≤ A ≤ 219

Refer also to abstracts 1295, 1307, 1310, 1338, 1339, 1347–1349, and 1362.

1370 (CONF-720669–, pp 233-251) METHODS, RESULTS, AND PROBLEMS INVOLVED WHEN ISOTOPE SEPARATORS ARE USED TO STUDY SHORT-LIVED NUCLEI FAR FROM STABILITY. Naumann, R. A. (Princeton Univ., NJ). 1972.
In Proceedings of Heavy-Ion Summer Study.

1371 (CONF-720669–, pp 252-268) PREDICTED PROPERTIES OF NUCLEI FAR FROM THE STABILITY LINE. Sorensen, R. A. (Carnegie-Mellon Univ., Pittsburgh). 1972.
In Proceedings of Heavy-Ion Summer Study.

1372 (CONF-720669–, pp 287-314) UNIFIED PICTURE OF FISSION AND HEAVY-ION PHYSICS. Mosel, U. (Univ. of Washington, Seattle). 1972.
In Proceedings of Heavy-Ion Summer Study.

1373 (CONF-730312–1) SINGLE-NUCLEON TRANSFER REACTIONS AND INELASTIC SCATTERING INDUCED BY ^{11}B IONS INCIDENT ON ^{208}Pb. Ford, J. L. C. Jr.; Toth, K. S.; Hensley, D. C.; Gaedke, R. M.; Riley, P. J.; Thornton, S. T. (Oak Ridge National Lab., Tenn.). 1973. 9p. Dep. NTIS $3.00.
From symposium on heavy-ion transfer reactions; Argonne, Illinois, USA (15 Mar 1973).
^{208}Pb was bombarded with 72-MeV ^{11}B ions accelerated in the Oak Ridge Isochronous Cyclotron. With the use of a 60-cm long, 3-wire, position-sensitive proportional detector placed in the focal plane of a broad-range magnetic spectrograph, all four single-nucleon-transfer reactions products were identified. Angular distribution measurements were completed for five final states in ^{209}Bi populated in the reaction ^{208}Pb(^{11}B,^{10}Be) and for three states in ^{207}Pb populated in the reaction ^{208}Pb(^{11}B,^{12}B). The differential cross sections are single peaked and smooth. As reported for the analogous reaction ^{208}Pb(^{12}C,^{11}B)^{209}Bi, the indication is that for the proton stripping reaction the peak angles remain constant with increasing excitation energy in ^{209}Bi. Angular distributions for inelastic scattering to the 3^-, 5^-, and 2^+ states at 2.62, 3.20, and 4.10 MeV in ^{208}Pb were also measured. (auth) (4 figures)

1374 (COO-3244-18) MIXING OF TWO-PARTICLE TWO-HOLE STATES IN ^{208}Po. Bhatia, T. S.; Canada, T. R.; Barnes, P. D.; Eisenstein, R.; Ellegaard, C.; Romberg, E. (Pittsburgh Univ., Pa. (USA). Nuclear Physics Lab.; Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Physics). 1972. 13p. Dep. NTIS $3.00.
States of ^{208}Po up to an excitation energy of 2 MeV were investigated via the two-neutron pickup reaction ^{210}Po(p,t)^{208}Po. Angular distributions were obtained for the five observed states of ^{208}Po, and $J\pi$ assignments were made. These states are discussed in terms of the excitation of simple modes observed in ^{206}Pb and ^{210}Po. Matrix elements were extracted for the interaction between the two-neutron-hole 2^+ excitations and the two-proton-particle 2^+ excitations, and compared with simple theoretical estimates. (auth)

1375 GAMMA-RAY ENERGIES OF ^{192}Ir. Inoue, H. (Hiroshima Univ.); Yoshizawa, Y.; Morii, T. Nucl. Instrum. Methods; 108: No. 2, 385-386(1973).
The energy of the ^{192}Ir 296-keV gamma ray was measured with the standard of ^{183}Ta by using Ge(Li) detectors. The observed value is 295.949 ± 0.004 keV on the basis of the 1969 physical constants. Other gamma-ray energies of ^{192}Ir are obtained from energy differences of previous measurements and the Ritz rule. (1 figure, 3 tables) (auth)

Nuclear Properties and Reactions, A ≥ 220

Refer also to abstracts 608, 1335, 1342, 1347, 1348, and 1372.

1376 (CONF-720669–, pp 38-54) SOME NUCLEAR STRUCTURE RESULTS FROM COULOMB EXCITATION. McGowan, F. K. (Oak Ridge National Lab., TN). 1972.
In Proceedings of Heavy-Ion Summer Study.

1377 (CONF-720669–, pp 83-93) EXPERIMENTAL METHODS FOR DETECTION AND IDENTIFICATION OF SUPERHEAVY NUCLEI PRODUCED IN HEAVY-ION REACTIONS. Enge, H. A. (Massachusetts Inst. of Tech., Cambridge). 1972.
In Proceedings of Heavy-Ion Summer Study.

1378 (CONF-720669–, pp 406-429) PREDICTED CHEMICAL PROPERTIES OF SUPERHEAVY ELEMENTS. Fricke, B. (Northwestern Univ., Wilmette, IL). 1972.
In Proceedings of Heavy-Ion Summer Study.

1379 (CONF-720669–, pp 430-437) PREDICTION OF CHEMICAL PROPERTIES OF THE SUPERHEAVY ELEMENTS. Keller, O. L. Jr. (Oak Ridge National Lab., TN). 1972.
In Proceedings of Heavy-Ion Summer Study.

1380 (CONF-720669–, pp 452-464) PROBLEMS OF ELECTRODYNAMICS OF STRONG FIELDS AND THEIR POSSIBLE TESTS IN HEAVY-ION COLLISIONS. Mueller, B.; Rafelski, J.; Soff, G.; Greiner, W. (Univ., Frankfurt am Main). 1972.
In Proceedings of Heavy-Ion Summer Study.

1381 (CONF-720669–, pp 474-490) INNER-SHELL COULOMB IONIZATION BY HEAVY-ION COLLISIONS. Richard, P. (Univ. of Texas, Austin). 1972.
In Proceedings of Heavy-Ion Summer Study.

1382 (INIS-mf-448) FISSION PROCESS ACCOMPANIED BY ALPHA PARTICLES IN ^{235}U. Gazit, Y. (Hebrew Univ., Jerusalem (Israel)). Mar 1972. 73p. (In Hebrew). INIS.
Thesis.
The angular and energy distribution of alpha particles—"Long Range Alphas" (LRA)—emitted during fission can be used to study the scission point. The experiment was carried out inside the thermal column of the IRR-1 reactor. The fission chamber included four solid state surface barrier detectors and a uranium target. Two fixed detectors measured the fission fragments, while the other two detectors were attached to a rotating arm and measured the alpha particles. The uranium target contained some 90 μg/cm^2 of ^{235}U, and was situated at the center of the chamber and rotated together with the two alpha detectors. The events were recorded on paper tape and analysed by a computer; whereas the kinetic energy spectra of the LRA and fission fragments are in reasonable agreement with the literature, the angular distribution is narrower. A suitable geometry in the experiment caused a maximum error of 4% in the counting rate as against 20% for an unsuitable geometry. Correlations are shown between the detector and source dimensions and the broadening of the angular distribution, account being taken of the alpha recoil influence. Trajectory calculations were performed which permitted the evaluation of a set of "starting parameters" describing the conditions at the scission point. Contrary to the predictions of the statistical fission model, it was shown that the fission fragments and the LRA at the scission point have velocities close to half the final velocity. The high E_{F_2} value was found to be in agreement with the liquid drop calculation of Nix. The emission point of the LRA was found to be moved 1 to 2 fm towards the light fragment when the fission went from symmetric to asymmetric. A qualitative explanation of the movement direction of the LRA emission point is given as a function of R from the Terrell curves. (INIS)

1383 (JINR-E7-7023) NONOBSERVATION OF THE SPONTANEOUSLY FISSIONING ACTIVITY OF KURCHATOVIUM-259 BY THE BERKELEY GROUP. Druin, V. A.; Korotkin, Yu. S.; Kharitonov, Yu. P.; Krashonkin, V. I.; Lobanov, Yu. V.; Nadkarni, D. M.; Tret'yakova, S. P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1973. 13p. Dep. NTIS (U. S. Sales Only) $3.00.
The nuclide kurchatovium-259 was synthesized in the nuclear reaction ^{246}Cm + ^{18}O. Its spontaneously fissioning activity was observed, and the spontaneous fission branching was estimated to be about 7%. The Berkeley work on the radioactive properties of kurchatovium isotopes is analyzed to show that the spontaneously fissioning activity had not been observed there because of the insufficient sensitivity of the method used. (1 figure) (auth)

1384 CHARGE DISTRIBUTION IN NEUTRON-INDUCED FISSION OF THORIUM. Rao, S. A.; Kuroda, P. K. (Univ. of Arkansas, Fayetteville). J. Inorg. Nucl. Chem.; 35: No. 5, 1443-1449 (May 1973).
Independent-fission yields of ^{117}In, ^{130}I, ^{132}I, ^{133}I, and ^{134}I in 14.8-MeV neutron-induced fission of ^{232}Th were determined to be (1.6 ±

$0.4) \times 10^{-2}$, $(2.2 \pm 0.5) \times 10^{-2}$, $(1.1 \pm 0.2) \times 10^{-1}$, $(4.4 \pm 1.0) \times 10^{-1}$ and $(6.4 \pm 1.5) \times 10^{-1}$ percent, respectively. The experimental results were analyzed by applying various charge postulates. The charge distribution, which is different for asymmetric and symmetric regions of the mass-yield curve, was interpreted previously in terms of two separate modes of fission. The results of this investigation and the previous measurements of the independent yields both in asymmetric and symmetric regions of the mass-yield curve showed strongly in favor of the Two-Mode-Fission-Hypothesis. (auth)

1385 GAMMA RAYS EMITTED FROM ELEMENTS PRODUCED IN THE THERMAL FISSION OF ^{235}U. Rollins, R. D. Urbana, IL; Univ. of Illinois (1972). 99p. University Microfilms Order No. 73-10,038.

Thesis (Ph. D.).

The x and gamma rays emitted from fission fragments of ^{235}U were studied. The low-energy excited levels in fission fragments de-excite by the competing processes of gamma-ray emission and internal conversion. If internal conversion occurs, x rays may be emitted. The x-ray detector was a high-resolution Si(Li) semiconductor detector, and the gamma-ray detector was a high-resolution Ge(Li) semiconductor detector. The energies of gamma and x rays detected in coincidence with one another and fission were recorded as two parameters, event by event. The characteristic x-ray energies allowed the determination of the atomic numbers of the de-exciting nuclei. The gamma-ray data were sorted to give gamma-ray spectra emitted from the individual elements. In general, several gamma-ray energy lines could be attributed to each element produced in fission. Additional single-parameter measurements were made of x and gamma rays emitted in coincidence with fission. X-ray yields were determined, and gamma-ray energy lines in the gross fission gamma-ray spectra were tabulated. (Diss. Abstr. Int., B)

1386 MOESSBAUER STUDIES OF ELECTROSTATIC HYPERFINE INTERACTIONS IN ^{238}U, ^{236}U, AND ^{234}U. Monard, J. A. Knoxville, TN; Univ. of Tennessee (1972). 96p. University Microfilms Order No. 73-2478.

Thesis (Ph. D.).

The nuclear gamma resonance (NGR) for ^{238}U, ^{236}U, and ^{234}U in the compound $(UO_2)Rb(NO_3)_3$ was established at 4.2°K following the alpha decay of PuO_2 sources. The ratios of the electric quadrupole moments of these isotopes were determined, and the electric field gradient at the uranium site was calculated from the data. The isomer shift in ^{234}U was measured for both PuO_2 and $PuAl_4$ sources, and the change in nuclear radius between the excited and the ground state was calculated. (Diss. Abstr. Int., B)

1387 TOTAL NEUTRON CROSS SECTIONS OF ^{238}U FROM 0.8 TO 30 MeV. Hayes, S. H.; Stoler, P.; Clement, J. M.; Goulding, C. A. (Rensselaer Polytechnic Inst., Troy, NY). Nucl. Sci. Eng.; 50: No. 3, 243-247(Mar 1973).

A measurement of the total neutron cross sections of ^{238}U was made using the Rensselaer Polytechnic Institute electron LINAC. The operating electron energy was about 60 MeV, and the beam burst width was 20 nsec. The neutron energies were determined using the time-of-flight technique with an overall resolution of 0.1 nsec/m. The cross sections are presented from 0.8 to 30.0 MeV; the cross-section curve is smooth in this region, and the averaged data have a statistical precision of 1%. The data reported have been compared with the ENDF/B-III file. The disagreements are within 2% over the energy range 0.8 to 15 MeV. In addition, the experimental cross sections were fit using coupled channel code JUPITOR to obtain optical model and deformation parameters. (auth)

1388 ^{252}Cf FISSION NEUTRON SPECTRUM FROM 0.5 TO 13 MeV. Green, L.; Mitchell, J. A.; Steen, N. M. (Westinghouse Electric Corp., West Mifflin, PA). Nucl. Sci. Eng.; 50: No. 3, 257-272(Mar 1973).

The ^{252}Cf prompt-fission-neutron spectrum has been measured by time-of-flight techniques over the energy range 0.5 to 13 MeV. Significant analytical and experimental improvements over earlier measurements were employed. The data were simultaneously analyzed with the angular pattern data of Bowman et al. (1962), using a model which includes anisotropy of emission in the neutron fragment coordinate system and a stationary source. Based on this analysis, the mean energy is found to be 2.105 ± 0.014 MeV. It is also concluded that the fragment emission spectra are highly anisotropic. The anisotropy is dictated by the data presented, rather than by angular patterns. The existence of the stationary source is supported by both data types. A Maxwellian fit to the data provided a temperature parameter of 1.406 ± 0.015 MeV. While the spectrum clearly deviates from a Maxwellian, this simple representation was found to be adequate to ±5% from 0.7 to 8.0 MeV. (auth)

1389 MEASUREMENTS OF EQUILIBRIUM AND TIME-DEPENDENT ENERGY SPECTRA OF BETA RAYS FROM ^{252}Cf FISSION FRAGMENTS. Knief, R. A. Urbana, IL; Univ. of Illinois (1972). 76p. University Microfilms Order No. 73-9970.

Thesis (Ph. D.).

An absolute determination of the beta radiation emitted by fission fragments produced by spontaneous fission of ^{252}Cf was made. Beta rays were detected by a plastic scintillator and the fission rate was monitored by a semiconductor surface-barrier detector. The equilibrium spectrum was measured from a ^{252}Cf source permanently encapsulated between two mylar foils thick enough to stop the fragments. The time-dependent measurements used a ^{252}Cf source supported on a thin Ni foil and covered with a thin collodion foil. Virtually all fragments from this second source escaped the foils. The time dependence of the ^{252}Cf beta-ray energy spectrum was measured for two cases: buildup of the spectrum following initiation of fragment collection on initially clean catcher foils and decay of the spectrum following a period of fragment collection. All of the measured spectra were corrected for energy resolution effects by unfolding them with the use of a measured system response function. The results of the measurements were used to calculate the decay of the beta-ray energy spectrum following an instantaneous burst of fissions. The measured data were used to generate empirical expressions for the beta-ray spectrum from ^{252}Cf fission fragments. The total number of betas per fission and the total beta energy per fission were calculated for various times for the buildup, decay, and instantaneous fission cases. The beta-ray energy spectrum for spontaneous fission of ^{252}Cf was compared with the spectrum for thermal neutron fission of ^{235}U. High-energy transitions (5 to 10 MeV) found in the latter was not found in the ^{252}Cf spectrum. (RWR)

Nuclear Theory

Refer also to abstracts 1149, 1195, 1298, 1397, and 1519.

1390 (CONF-720669–, pp 55-67) MOMENTS OF INERTIA AT HIGH ANGULAR MOMENTUM. Sorensen, R. A. (Carnegie Mellon Univ., Pittsburgh). 1972.

In Proceedings of Heavy-Ion Summer Study.

1391 (CONF-720669–, pp 68-77) HIGH SPIN STATES IN EVEN–EVEN NUCLEI. Stephens, F. S. (Univ. of California, Berkeley). 1972.

In Proceedings of Heavy-Ion Summer Study.

1392 (CONF-720669–, pp 78-82) VALIDITY OF CLASSICAL DYNAMICAL CALCULATIONS OF THE COULOMB BARRIER HEIGHT IN HEAVY-ION COLLISIONS. McVoy, K. W. (Univ. of Wisconsin, Madison). 1972.

In Proceedings of Heavy-Ion Summer Study.

1393 (CONF-720669–, pp 94-108) COULOMB INTERACTIONS WITH HEAVY IONS. Alder, K. (Univ., Basel). 1972.

In Proceedings of Heavy-Ion Summer Study.

1394 (CONF-720669–, pp 109-122) HIGH ANGULAR MOMENTUM STATES IN ODD-A VIBRATIONAL NUCLEI. Stephens, F. S. (Univ. of California, Berkeley). 1972.

In Proceedings of Heavy-Ion Summer Study.

1395 (CONF-720669–, pp 123-147) FISSION AND HEAVY IONS. Griffin, J. (Univ. of Maryland, College Park). 1972.

In Proceedings of Heavy-Ion Summer Study.

1396 (CONF-720669–, pp 148-162) FORMATION OF THE COMPOUND NUCLEUS, REACTION AND COMPLETE FUSION CROSS SECTIONS, DECAY OF THE COMPOUND NUCLEUS, HIGH EXCITATION ENERGIES, AND HIGH ANGULAR MOMENTUM. Thomas, T. D. (Oregon State Univ., Corvallis). 1972.

In Proceedings of Heavy-Ion Summer Study.

1397 (COO-1051-56) DESCRIPTION OF INELASTIC (p,p') SCATTERING. Schaeffer, R. (Michigan State Univ., East Lansing; Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1970. 19p. (CONF-710983-1). Dep. NTIS $3.25.

From symposium on the two-body force in nuclei; East Lansing, Michigan, USA (7 Sep 1971).

The reliability of information on excited states of nuclei obtained by inelastic proton scattering is assessed. The DWBA is commonly used to describe this process. The vibrational model is taken up, and it is suggested that its success comes about because it provides the correct geometrical features of p inelastic scattering and not because the underlying dynamical assumptions (i.e., a vibrational excitation) are correct. It is demonstrated that exchange effects are very important in proton inelastic scattering.

With these included, it is possible to obtain a quantitative description of p inelastic scattering without any adjustable parameter. The systematic dependence of exchange effects on the energy of the incident particle and on the transferred spin is pointed out. Thus, a nice quantitative description of proton inelastic scattering, including the energy and angular-momentum-transfer dependence, can be obtained by using either the Blatt–Jackson interaction or the Kallio–Kolltveit force. The main interest in having a quantitative theory of p inelastic scattering is to obtain new spectroscopic information on the excited states of a nucleus. For typical shell-model wave functions with closed p(n) shell and open n(p) shell, it is found that the proton and neutron behave much more symmetrically than predicted by current nuclear models. (8 figures, 2 tables) (RWR)

1398 (COO–3001-33) FOUR-NUCLEON TRANSFER REACTIONS AMONG HEAVY IONS. Arima, A.; Broglia, R. A.; Ichimura, M.; Schaefer, K. (State Univ. of New York, Stony Brook. Dept. of Physics). 1973. Contract AT(11-1)-3001. 67p. Dep. NTIS $5.50.

A general derivation of form factors for four-nucleon-transfer reactions between heavy ions is given within the framework of the DWBA. The reaction $^{16}O(^{16}O,^{12}C)^{20}Ne$ is studied as an example in the Buttle–Goldfarb approximation. For the potential entering the DWBA integral an effective potential V^{eff} between the transferred α particle and the core nucleus is chosen. The influence of different choices for V^{eff} is studied, and the results for post and prior form are compared. (auth) (13 figures, 3 tables)

1399 (FEI–243) ANALYSIS OF ANGULAR DISTRIBUTIONS OF NEUTRONS SMALL-ANGLE SCATTERED BY URANIUM AND NEUTRON POLARIZABILITY. Anikin, G. V.; Kotukhov, I. I. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut). 1971. 26p. (In Russian). INIS.

The question of the addition of the polarization potential to the nuclear optical potential with a large number of parameters was examined. It was shown that in this case the assumption on the presence of neutron polarizability appears to obtain significant improvement in the description of the angular distribution of scattered neutrons. (tr-auth)

1400 (FEI–253) ALIGNMENT OF COMPOUND NUCLEI BY ORBITAL MOMENTUM OF INCIDENT PARTICLE. Kozlovskii, L. K.; Rabotnov, N. S. (Gosudarstvennyi Komitet po Ispol'Zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko Energeticheskii Institut). 1971. 9p. (In Russian). INIS.

It was shown that a common statement on the alignment of compound nuclei in planes, perpendicular to the beam, generally speaking, is incorrect; in some cases, as a function of the relation between the spin of the target nucleus and orbital momentum of the incident particle there can be produced a rather strong reverse effect, that is, preferential alignment along the direction of the beam. The value of the alignment of the compound nucleus as a function of the spin of the target nuclei and the neutron momentum was calculated. The results obtained were discussed as applied to the angular distribution of the fragments from neutron fission of the nucleus. (tr-auth)

1401 (INP-810) ROLE OF LONGITUDINAL MOMENTUM TRANSFER IN HIGH ENERGY HADRON SCATTERING FROM NUCLEI. Bleszynska, E.; Bleszynski, M. (Institute of Nuclear Physics, Krakow (Poland)). Oct 1972. 14p. Dep. NTIS (U. S. Sales Only) $3.00.

It is shown that the inclusion of the longitudinal momentum transfer into the multiple scattering formula of Glauber results in appreciable changes in the elastic cross sections near the diffractive minima. (auth)

1402 (INP-812) INELASTIC SUM RULE FOR HIGH-ENERGY HADRON SCATTERING AND NUCLEON–NUCLEON CORRELATIONS. Bleszynska, E.; Bleszynski, M.; Malecki, A.; Picchi, P. (Institute of Nuclear Physics, Krakow (Poland)). Oct 1972. 16p. Dep. NTIS (U. S. Sales Only) $3.00.

The influence of short-range dynamical and statistical correlations on the elastic and summed inelastic scattering of high energy hadrons from light nuclei were considered. The calculations are based on the complete multiple scattering series of Glauber. The correlation effects are discussed on the example of the inelastic sum rule for p–^{16}O scattering. (auth)

1403 (ITEF–857) ELECTROMAGNETIC CORRECTIONS TO SCATTERING OF FAST CHARGED PARTICLES BY NUCLEI. Kondratyuk, L. A.; Kopeliovich, V. B. (Gosudarstvennyi Komitet po Ispol'Zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi I Eksperimental'Noi Fiziki). 1971. 16p. (In Russian). INIS.

In a study on the basis of the Glauber formula with account taken of the Coulomb correction, an expression was obtained for the amplitude of the scattering of π mesons by nuclei at high energies $E \gg R^{-1}$ and small momentum transfer $t = \Delta^{-2} \lesssim R^{-2}$. As during the scattering of the particles at high energy and small angles considerations of spin are unimportant, the formula obtained is immediately generalized to the scattering of protons and electrons. The range of applicability and the errors of the generalized Glauber formula at $A \gg 1$ were examined. (tr-INIS)

1404 (JINR-E4-6989) EXCITATION OF NUCLEI NEAR THE COULOMB BARRIER. Lukyanov, V. K.; Titov, A. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 23p. Dep. NTIS (U. S. Sales Only) $3.25.

The coupled-channel method together with the trajectory description of projecile movement are used in investigating the excitation of nuclei near the Coulomb barrier. It was found that the excitation probabilities are very sensitive to the change of nuclear potential parameters and electromagnetic transition probabilities. The numerical calculations are in a good agreement with existing experimental data. (7 figures, 1 table) (auth)

1405 (JINR–P4-6947) ISOTOPE SHIFT OF THE STRENGTH FUNCTION IN THE MINIMUM. Nikolenko, V. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1973. 20p. (In Russian). Dep. NTIS (U. S. Sales Only). $3.00

An expression is obtained for the amplitude of the reduced width of the compound states in the framework of R-matrix theory with the wave functions antisymmetrized in all neutrons. Pair correlations of a superconducting type lead to an isotope shift in the strength functions. Calculation, performed for Sn and Te isotopes, agrees well with experiment. (3 figures) (auth)

1406 (JINR–P4-6997) EFFECTS OF ELECTRON AND PROTON DISTORTIONS IN (e,e'p) REACTIONS. Gorchakov, V. V; Luk'yanov, V. K.; Pol, Yu. S.; Reznik, B. L. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 24p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

The quasi-elastic (e,e'p) cross section was derived with the Coulomb distortion of electrons taken into account in the framework of the high-energy approximation. In comparison with the plane-wave approach in the usual kinematics, the $d^4\sigma$ cross section of the ^{40}Ca(e,e'p) reaction is increased in absolute value by 10 to 20% due to the electron distortion and decreased 3 to 4 times due to the inclusion of the proton optical potential; if one then takes into account the diffuseness of nuclei in the hole state dynamic potential, the relative magnitude of the cross section in the region of the 1p and 1s peaks is increased 2 to 3 times. (4 figures) (auth)

1407 (JINR-P4-6999) APPLICATION OF THE BATEMAN METHOD TO CALCULATION OF SOME PROPERTIES OF NUCLEAR MATTER. Belyaev, V. B.; Irgaziev, B. F. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The problems of bound states of two and three nucleons in nuclear matter are considered. The average energy per nucleon is determined as a function of density for two potentials of the "soft-core" type. The two-particle potential in the momentum representation is approximated by the Bateman method. (4 figures) (auth)

1408 (JINR–P4-7046) NEUTRON RESONANCE STRUCTURE. Solov'ev, V. G. (Joint Inst. For Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

A new approach to the study of the neutron resonance structure is considered; it is realized, first, by a general semimicroscopic description based on the operator form of the wave function, and, secondly, by numerical calculations within the model which take into account the interactions of quasi-particles with phonons. (3 figures) (auth)

1409 (RT/FI-(72)50) "PIUME" CODE FOR THE MULTILEVEL TWO-CHANNEL CROSS SECTION CALCULATIONS. Martinelli, T.; Motta, M. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 21 Dec 1972. 34p. Dep. NTIS (U. S. Sales Only) $3.75.

A multilevel two-channel code which calculates the neutron cross section in the resolved resonance region is described. The principal feature exhibited by the code is the possibility of evaluating the cross section with interference effects among the resonances due to the random signs of the reduced widths. The feature is obtained by means of a representation of the cross section for a given reaction as an Hermitean form of complex variables of special type. The totality of the possible different sequences of signs are then constructed by the code, and the corresponding cross section values for every neutron energy are obtained. (1 table) (auth)

1410 NONLOCALITY EFFECTS ON CHARGE-EXCHANGE AND INELASTIC SCATTERING. Satchler, G. R. (Oak Ridge National Lab., TN). Phys. Lett.; 44B: No. 1, 13-15(2 Apr 1973).

It is argued that it is not necessary to include correction factors for non-locality effects when using a generalized optical model for charge-exchange and inelastic scattering. (auth)

1411 PROCEEDINGS OF THE XV INTERNATIONAL SUMMER MEETING OF NUCLEAR PHYSICISTS ON NUCLEAR STRUCTURE, HERCEGNOVI, YUGOSLAVIA, AUGUST 17-29, 1970. Kukoc, A. H. (ed.). Belgrade; Boris Kidric Institute of Nuclear Science (1972). 525p. (CONF-700865-).

From 15th international summer meeting of nuclear physicists on nuclear structure; Hercegnovi, Yugoslavia (17 Aug 1970).

There were eight lectures included. Separate abstracts were prepared for all lectures. (JFP)

For abstracts of individual lectures see: 1412-1418 and 1519.

1412 DISTRIBUTION OF SINGLE PARTICLE ENERGIES IN A DEFORMED POTENTIAL WELL. Bloch, C. (CEN de Saclay, Gif-sur-Yvette, France). pp 20-54 of Proceedings of the XV International Summer Meeting of Nuclear Physicists on Nuclear Structure. Kukoc, A. H. (ed.). Belgrade; Boris Kidric Inst. of Nuclear Science (1972).

From 15th international summer meeting of nuclear physicists on nuclear structure; Hercegnovi, Yugoslavia (17 Aug 1970). See CONF-700865-.

An asymptotic analytic procedure for the determination of the single-particle levels in a deformed potential is given. (JFP)

1413 NUCLEAR STRUCTURE AND HEAVY-ION PHYSICS. Greiner, W. (Univ., Frankfurt am Main). pp 55-183 of Proceedings of the XV International Summer Meeting of Nuclear Physicists on Nuclear Structure. Kukoc, A. H. (ed.). Belgrade; Boris Kidric Inst. of Nuclear Science (1972).

From 15th international summer meeting of nuclear physicists on nuclear structure; Hercegnovi, Yugoslavia (17 Aug 1970). See CONF-700865-.

The topics discussed include collective potential energy surfaces in nuclei, possible islands of superheavy nuclei, renormalization of collective potential energy surfaces, and the two-center shell model. Also heavy ion scattering and quasimolecular nuclear states, quasimolecular structure in elastic oxygen-16-oxygen-16 scattering, and potentials for fast and slow heavy-ion collisions within the two center shell model are covered. (JFP)

1414 SELECTED TOPICS ON NUCLEAR VIBRATIONS. Paar, V. (Univ. of Copenhagen). pp 234-386 of Proceedings of the XV International Summer Meeting of Nuclear Physicists on Nuclear Structure. Kukoc, A. H. (ed.). Belgrade; Boris Kidric Inst. of Nuclear Science (1972).

From 15th international summer meeting of nuclear physicists on nuclear structure; Hercegnovi, Yugoslavia (17 Aug 1970). See CONF-700865-.

The discussion includes the five-dimensional harmonic vibrator, anharmonicities in the vibrational model, diagramatic method of the particle-vibrational coupling model, phonon anharmonicities, and anharmonicities due to the existence of single-particle clusters. (JFP)

1415 SEMIMICROSCOPIC DESCRIPTION OF NUCLEAR VIBRATIONS. Solovev, V. G. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 388-435 of Proceedings of the XV International Summer Meeting of Nuclear Physicists on Nuclear Structure. Kukoc, A. H. (ed.). Belgrade; Boris Kidric Inst. of Nuclear Science (1972).

From 15th international summer meeting of nuclear physicists on nuclear structure; Hercegnovi, Yugoslavia (17 Aug 1970). See CONF-700865-.

Lectures are presented on the description of nuclear vibrations in the framework of semimicroscopic theory. The basic equations are derived by the self-consistent field method. The problem of complication of the state structure with increasing excitation energy is studied using the approximate second quantization method. (JFP)

1416 OFF-SHELL BEHAVIOUR OF THE NUCLEON-NUCLEON INTERACTION. Sprung, D. W. L. (Institut de Physique Nucleaire, Orsay, France). pp 436-480 of Proceedings of the XV International Summer Meeting of Nuclear Physicists on Nuclear Structure. Kukoc, A. H. (ed.). Belgrade; Boris Kidric Inst. of Nuclear Science (1972).

From 15th international summer meeting of nuclear physicists on nuclear structure; Hercegnovi, Yugoslavia (17 Aug 1970). See CONF-700865-.

A review is given of work directed toward understanding the off-energy-shell properties of the nucleon-nucleon force. The $^1S_0$ state is primarily discussed. (JFP)

1417 HARTREE-FOCK-BOGOLYUBOV EQUATIONS AND A MICROSCOPIC THEORY OF NUCLEAR ROTATIONS. Ring, P. (Technical Univ., Munich). pp 482-496 of Proceedings of the XV International Summer Meeting of Nuclear Physicists on Nuclear Structure. Kukoc, A. H. (ed.). Belgrade; Boris Kidric Inst. of Nuclear Science (1972).

From 15th international summer meeting of nuclear physicists on nuclear structure; Hercegnovi, Yugoslavia (17 Aug 1970). See CONF-700865-.

The lecture on the problem of a microscopic description of nuclear rotations covers projected Hartree-Fock-Bogolyubov equations, numerical calculations in the even case, and odd-particle number. (JFP)

1418 PROTON-NEUTRON CORRELATION IN THE FRAMEWORK OF HFB THEORY. Wolter, H. H. (Univ., Muenster, Ger.). pp 498-525 of Proceedings of the XV International Summer Meeting of Nuclear Physicists on Nuclear Structure. Kukoc, A. H. (ed.). Belgrade; Boris Kidric Inst. of Nuclear Science (1972).

From 15th international summer meeting of nuclear physicists on nuclear structure; Hercegnovi, Yugoslavia (17 Aug 1970). See CONF-700865-.

Previous calculations on the proton-neutron correlation are given and cover a review of Hartree-Fock-Bogolyubov equations, pairing model in HFB theory, specialization of pairing theory, and pairing models and realistic T = 1 calculations. (JFP)

1419 DETERMINATION OF THE ANGULAR MOMENTUM DISTRIBUTION OF HIGHLY EXCITED NUCLEI FROM THE ISOMER RATIOS FOR (n,2n) REACTIONS. Winiwarter, P.; Hille, P. Oesterr. Akad. Wiss. Math.-Naturwis. Kl., Anz.; 108: 71-73(1971). (In German).

For nuclei with an atomic number higher than 70 and for impact energies of about 15 MeV, the isomer ratios of the (n,2n) reaction were compiled from the literature and complemented by measured data. Based on the Fermi gas model with fictive ground state, the theoretical isomer ratios were then calculated according to Gilbert and Cameron. Results showed that the energy dependence of the parameter for angular momentum must be taken into account. Of particular importance was the exact treatment of the gamma cascades in the nucleus before reaching the final isomer state. It was concluded that the Vandenbosch-Huizenga method yielded satisfactory results when the surface density was assumed to be Fermi gas with fictive ground state and when the semiempirical values of Cameron were used for $\langle m^2 \rangle$. (HBG)

1420 NEW BOSON EXPANSION FOR ODD-PARTICLE SYSTEMS. Marshalek, E. R. (Univ. of Notre Dame, IN). Phys. Lett.; 44B: No. 1, 5-8(2 Apr 1973).

The Beliaev-Zelevinsky boson expansion is extended to include systems with odd particle number. Closed forms, valid to all orders, are given for the particle-boson as well as boson-boson interaction. (auth)

1421 ZERO-POINT ENERGY PROBLEM IN COLLECTIVE POTENTIALS WITH STRUTINSKY RENORMALIZATION. Maruhn, J.; Greiner, W. (Univ., Frankfurt am Main). Phys. Lett.; 44B: No. 1, 9-12(2 Apr 1973).

A method for the correct treatment of zero-point vibrations in collective potential energy surfaces calculated according to the Strutinsky prescription is proposed. Its effects on theoretical lifetime predictions are estimated in a simple model. (auth)

1422 RESONANCE CONTRIBUTIONS TO SUM RULES IN NUCLEAR PHYSICS. Berggren, T. (Lund Inst. of Tech., Sweden). Phys. Lett.; 44B: No. 1, 23-25(2 Apr 1973).

Completeness relations including resonant states are used to separate resonant contributions to general sum rules. (auth)

1423 TEMPERATURE EFFECTS IN THE LIQUID DROP DESCRIPTION OF NUCLEAR FISSION. Hasse, R. W.; Stocker, W. (Munich Univ., Garching, Ger.). Phys. Lett.; 44B: No. 1, 26-28(2 Apr 1973).

Using recent results of the dependence of the surface tension and nuclear equilibrium density of temperature from an extended Fermi gas model the invluence of temperature (compound nuclear excitation energy) on the liquid drop deformation energy and fission barrier height is studied. It is shown that increasing the temperature results in a lower fission barrier and a less constricted saddle point shape. (auth)

1424 THEORY OF TWO NEUTRON TRANSFER REACTIONS. Feng, D. H. Minneapolis; Univ. of Minnesota (1972). 112p. University Microfilms Order No. 73-10,552.

Thesis (Ph. D.).

Distorted-wave Born-approximation (DWBA) calculations for two-neutron-transfer reactions were performed via the Monte

Carlo method of integration. The total angular momentum transferred can be zero or nonzero. A finite-range interaction which acted between the proton and each transferred neutron, with spin-dependence, was used. The results support the conclusions of the natural-parity zero-range calculations, both with respect to the shapes of the angular distributions and the relative cross sections for the transfer into different shells. The absolute cross sections, calculated for the $^{40}Ca(t,p)^{42}Ca$ reaction, were only about $\frac{1}{3}$ the observed value in the $L^\pi = 0^+$ case and $\frac{1}{2}$ the observed value in the $L^\pi = 2^+$ case. For the unnatural-parity transitions, however, the calculated cross sections for the reactions $^{22}Ne(p,t)^{20}Ne$ (0^+ to 2^-) and $^{48}Ca(p,t)^{46}Ca$ (0 to 2^-) were about a thousandth as large as those observed, and the shape of the angular distributions showed great variations with the data. It was shown from study of the plane-wave Born approximation (PWBA) for two-neutron-transfer reactions that the zero-range angular distributions differed from the finite angular distributions by an exponential factor. The results of the DWBA calculations also support such a conclusion. (Diss. Abstr. Int., B)

1425 REALISTIC ONE-PARTICLE DENSITY MATRIX AND SINGLE-PARTICLE DESCRIPTION OF NUCLEI. Boffi, S.; Pacati, F. D. (Univ., Pavia, Italy). Nucl. Phys.; A204: No. 3, 485-496(1973).

With the experimental data on elastic electron scattering as a basis, realistic one-particle density matrices for ^{16}O and ^{40}Ca are obtained, both with fractional occupation numbers and full occupation of the first A natural orbitals. A phenomenological single-nucleon Hamiltonian is then constructed and diagonalized. The deduced single-particle energies are compared with those obtained in the Hartree–Fock approximation. The consistency of all experimental data concerning the ground state is checked with the aid of a sum rule for the total binding energy involving only the one-particle density matrix and the hole energies. (7 tables) (auth)

1426 PAIR CORRELATIONS AND THE COLLECTIVE O^+ STATES OF NUCLEI. II. Jolos, R. V.; Doenau, F.; Kartavenko, V. G.; Janssen, D. (Joint Inst. for Nuclear Research, Dubna, USSR). Teor. Mat. Fiz.; 14: No. 1, 70-81(Jan 1973). (In Russian).

A finite boson representation of fermion operators was obtained for the Hamiltonian with pairing forces in the system of the two kinds of nucleons. A collective Hamiltonian describing pair excitations was constructed. The case of the strong pair correlations was analyzed; in this case the basis functions were obtained for the expansion of the exact solution. (auth)

1427 OSCILLATOR CLUSTER PARENTAGE AND SUPERMULTIPLET EXPANSION FOR STATES OF LIGHT NUCLEI. Kramer, P.; Schenzle, D. Nucl. Phys.; A204: No. 3, 593-608 (1973).

Cluster parent states are defined in terms of excited oscillator states of high excitation. The expansion in terms of these states is highly selective and keeps the lowest supermultiplets. The matrix elements of the nuclear Hamiltonian are reduced to two-body matrix elements and generalized transformation brackets. Calculations for ^6Li levels are reported. (1 figure, 3 tables) (auth)

1428 GEOMETRIC PROPERTIES OF LEPTODERMOUS DISTRIBUTIONS WITH APPLICATIONS TO NUCLEI. Myers, W. D. (Univ. of California, Berkeley). Nucl. Phys.; A204: No. 3, 465-484(1973).

Relationships between geometrical properties of leptodermous distributions are employed in the interpretation of experimentally determined nuclear density distributions and optical-model potential wells. It is found that nuclear sizes imply a density for neutral symmetric nuclear matter corresponding to $r_0 = 1.16$ fm ($k_f = 1.31$ fm^{-1}) and that the densities and potentials can be related to each other by means of a saturating two-body interaction. (8 figures) (auth)

1429 EXCITED STATES $J^\pi = 1^+$ IN SPHERICAL NUCLEI. Cwiok, S.; Wygonowska, M. (Univ., Warsaw). Acta Phys. Pol., B4: No. 2, 233-249(1973).

Energies, wave functions and M1 electromagnetic transition widths have been calculated for ^{55}Ni, $^{114,116,118,120,122,124}Sn$, ^{138}Ba, ^{140}Ce, ^{142}Nd and ^{208}Pb with the use of the Saxon–Woods potential and "realistic" residual forces. Several excited states $J^\pi = 1^+$ in the energy region 2.3 to 12.4 MeV have been obtained for each nucleus. Some of these states are a coherent mixture of configurations generated by spin-orbit interaction and have a large width for M1 electromagnetic transitions. (auth)

1430 EFFECT OF THE RESONANCE PRODUCTION ON THE NUCLEAR REACTION MECHANISM. Il'inov, A. S.; Toneev, V. D. (Joint Inst. for Nuclear Research, Dubna, USSR). Acta Phys. Pol.; B4: No. 2, 225-231(1973). (In Russian).

The resonance production processes are taken into account in the framework of the cascade model. It is shown that variation in the nuclear reaction mechanism, occurring at about (3 to 5) GeV in the region of medium-weight nuclei, is explained not by the effect of resonances, produced in the internuclear particle collisions, but by the previously considered effect of the local reduction of the nuclear density in proportion to the cascade development. It is pointed out that the contribution of the "many-particle" collisions is unessential in the energy region T < 30 GeV. (auth)

1431 PROBLEM OF ANGULAR CORRELATIONS IN DIRECT NUCLEAR REACTIONS. Titov, A. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Acta Phys. Pol.; B4: No. 2, 187-192(1973). (In Russian).

A formula is obtained for the angular correlation in direct nuclear reactions of the type $A + \alpha \rightarrow B + \beta \rightarrow C + \gamma + \beta$. The specific case of the plane-wave approximation is analyzed and distortions within the framework of the high energy approximation of the reaction $^{12}C + {}^6Li \rightarrow {}^{16}O + d \rightarrow {}^{12}C + \alpha + d$ are calculated. (auth)

1432 INTERACTION OF RELATIVISTIC DEUTERIUM AND TRITIUM NUCLEI WITH PHOTOEMULSION ONES. Barashenkov, V. S.; Il'inov, A. S.; Toneev, V. D. (Joint Inst. for Nuclear Research, Dubna, USSR). Acta Phys. Pol.; B4: No. 2, 219-224(1973). (In Russian).

Inelastic collisions of the deuterons and tritium nuclei with photoemulsion in the energy range up to 30 GeV/nucleon were calculated within the framework of the intranuclear cascade model taking account of the changes in the nucleus-target properties in the process of interaction. In the energy dependence of the slow secondary particle multiplicity at the energy of the order of several GeV a maximum is predicted which is due to the decrease of the intranuclear matter density resulting from the knocking out of nucleons by the cascade particles. Reliability of the selection of interactions with photoemulsion hydrogen with the aid of the $n_h \leq 1$ criterion is discussed. (auth)

1433 TWO-STEP DEUTERON STRIPPING ON SPHERICAL NUCLEI. Gridnev, K. A.; Lukyanov, V. K.; Semenov, V. M. (Joint Inst. for Nuclear Research, Moscow). Acta Phys. Pol.; B4: No. 2, 167-172(1973).

The main features of the two-step effects, connected with one-phonon virtual excitations, are analyzed for allowed neutron transfers in the $^{52}Cr(d,p)^{53}Cr$ reaction. To this end the obvious expression for the cross sections obtained in the double adiabatic perturbation approach is calculated with the help of an ordinary DWBA-method. A mixture of the two-step effects to the usual one-step cross section is found to be about 10%, but with increasing incident energy from 10 to 20 MeV the effect increases approximately by a factor of two times. (auth)

1434 ANALYSIS OF EXCITATION FUNCTIONS IN HEAVY ION REACTIONS. Il'inov, A. S.; Toneev, V. D. (Joint Inst. for Nuclear Research, Dubna, USSR). Acta Phys. Pol.; B4: No. 2, 173-186(1973). (In Russian).

The possibilities of describing the behavior of excitation functions when applying the statistical models of nuclear reactions incorporating the angular moment of the disintegrating nucleus are studied. The sensitivity of these functions with respect to the choice of the model parameters is analyzed. The competitive effect of the γ-ray emission process and the role of the "critical" angular momentum are discussed. An analysis of the available experimental data provides values of the parameters which allow the yield cross sections for reactions involving heavy ions to be found with an accuracy of $k \approx 2-3$, and the position of the maximum in the excitation function with an accuracy of $\Delta E \approx (5-10)$ MeV. (auth)

PHYSICS (PLASMA AND THERMONUCLEAR)

1435 FUSION ENERGY AND THE FUTURE. Gough, W. C. (Atomic Energy Commission, Washington, DC). pp 1-50 of Chemistry of Fusion Technology. Gruen, D. M. (ed.). New York; Plenum Publishing Corp. (1972).

From symposium on the chemistry of fusion technology; Boston, Massachusetts, USA (12 Apr 1972). See CONF-720472-.

The importance that energy has played throughout man's history and some of the interrelationships that exist among man, energy, and the environment are discussed. Fusion energy and the chemist's and chemical engineer's part in the future of fusion are described. (MOW)

Confinement and Heating

1436 (CEA-CONF-2179) SURVEY OF MAIN TECHNOLOGICAL ACTIVITIES AT THE CENTRE d'ETUDES NUCLEAIRES AT FONTENAY-AUX-ROSES. *Ginot, P. (Commissariat a l'Energie* Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). [nd]. 26p. (CONF-721111-28). Dep. NTIS (U. S. Sales Only) $3.50.

From International meeting on the technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors; Austin, Texas, USA (20 Nov 1972).

The main technological effort of the laboratory is devoted to the confinement and heating of the plasma in the tokamak machines. Confinement in the TFR machine, which is now assembled, uses a classical technology (coils at room temperature, condenser banks, flywheel generator, rectifiers) improved to get good mechanical stand and good cooling at high performances: small plasma radius 20 cm, toroidal field 60 kG, pulse duration 0.5 sec. An additional heating is being prepared and uses an arrangement of fast neutral sources of known performance (~40 keV, 3 A) injecting a power comparable with the ohmic one at an angle close to transverse (10°). A study of a machine able to reach ignition is being done by optimizing the parameters and extrapolating the same technology and the same heating. Such a machine seems feasible with reasonable parameters (small plasma radius 1 m, toroidal field 42 kG, neutral power 100 keV, 75 A) if the thermal ionic conduction reaches the banana regime. (auth)

1437 (CONF-730315-4) QUASI-CLASSICAL DIFFUSION PROCESSES IN TOKAMAKS. Callen, J. D.; Hogan, J. T.; Waddell, B. V. (Oak Ridge National Lab., Tenn.). [nd]. 4p. Dep. NTIS $3.00.

From 3rd international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

The enhanced two-particle (quasi-classical) scattering due to long range polarization fields arising from convectively unstable drift waves and weakly damped current-driven ion acoustic waves are investigated to determine some of their effects on transport coefficients in tokamaks. (auth)

1438 (CONF-730315-5) THEORY OF NEUTRAL BEAM INJECTION INTO A TOKAMAK. Callen, J. D.; Clarke, J. F.; Rome, J. A. (Oak Ridge National Lab., Tenn.). [nd]. 4p. Dep. NTIS $3.00.

From 3rd international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

Plasma perturbations caused by injection of a neutral beam into a Tokamak plasma are examined to determine if there are any limitations to this method of heating and replenishing the plasma. (auth)

1439 (CONF-730315-7) NEUTRAL-BEAM-INJECTION HEATING OF TOKAMAKS. Stewart, L. D.; Callen, J. D.; Clarke, J. F.; Davis, R. C.; Dory, R. A.; Hogan, J. T.; Jernigan, T. C.; Morgan, O. B.; Rome, J. A.; Stirling, W. L. (Oak Ridge National Lab., Tenn.). 1973. 4p. Dep. NTIS $3.00.

From 3rd international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

A basic ORMAK neutral injection heating module has been developed which is capable of delivering 120 kW to the plasma with acceptable levels of impurities and streaming neutral gas. Independent variation of the energy, power, equivalent current, neutral species, time of injection and angle of injection will be possible. Significant increases in ion temperatures are expected when using these heaters. Plasma perturbations caused by injection of a neutral beam into a tokamak plasma are examined to determine if there are any limitations on this method of heating and replenishing the plasma. The use of feedback controlled neutral injection heating has been studied for stabilizing the operating temperature in a test fusion reactor design. (auth)

1440 (EUR-CEA-FC-668) ANALYTICAL STUDY OF THE EVOLUTION OF A TOKAMAK-TYPE NONCIRCULAR-CROSS-SECTION PLASMA. Maschke, E. K.; Pantuso Sudano, J. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Nov 1972. 57p. (In French). Dep. NTIS (U. S. Sales Only) $5.00.

A system of equations describing the temporal and spatial evolution of a fully ionized plasma having an arbitrary cross section is established. A quasi-stationary equilibrium is deduced using two-fluid MHD equations. It is assumed that the physical parameters intervening in this equation change slowly. The equations representing the changes occurring in these parameters are established. The form of these equations (t = 0) is studied for a particular choice of initial conditions: elliptical cross-sectioned *torus. (FR)*

1441 (EUR-CEA-FC-677) IGNITION BY TTMP HEATING IN THE FUTURE EUROPEAN TOKAMAK. Bernard, M.; Brifford, G.; Parlange, F. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Dec 1972. *(CONF-721082-1). Dep. NTIS (U. S. Sales Only) $3.25.*

From third meeting of the Joint Tokamak Working group; Culham, UK (10 Oct 1972).

Three preliminary projects for a future European Tokamak are currently being considered. The feasibility of transit-time magnetic pumping (TTMP) heating is examined. It appears that ignition can be reached by TTMP heating in each of the three skeleton tokamaks. The necessary rf modulation for the toroidal magnetic field is about 1 to 2×10^{-3}. The corresponding power which must be delivered by the oscillators is calculated together with the power dissipated in the rf coils. The results show that the only problems involved in the utilization of TTMP heating to reach ignition concern the insulation of the rf coils from the plasma column. (FR)

1442 (UCRL-74105) EFFECT OF FINITE BOUNDARIES AND OF FREQUENCY MODULATION ON TURBULENT HEATING INDUCED BY A MODERATELY STRONG HIGH FREQUENCY ELECTRIC FIELD. Faehl, R. J.; DeGroot, J. S.; Katz, J. I. (California Univ., Livermore. Lawrence Livermore Lab.). 27 Oct 1972. 14p. (CONF-721132-5). Dep. NTIS $3.00.

From plasma physics meeting of the American Physical Society; Monterey, California, USA (13 Nov 1972).

The most significant result derived from this work is that finite systems limit the maximum electron velocities attainable through turbulent heating. The main features of turbulent heating at this field strength in the infinite medium simulations, tail heating and power law mode amplitude spectra, were also observed in finite medium simulations but somewhat modified. It was also shown that a finite bandwidth/amplitude modulation of the driving field does not inhibit either the growth of the plasma fields or the turbulent heating they induce. Phase modulation of the driving field still seems promising as a technique for limiting the maximum velocities to which particles can be turbulently accelerated. At this time, though, the only conclusive result has been that the heating rate can be reduced by a factor of between two and ten. The boundary conditions used were based on the assumption that the return flux of particles would be due to the relatively cold plasma surrounding the heating region. This was probably adequate to separate the effects of an infinite medium from those due to a finite medium but it neglects two major effects. The first is that the hot flux due to suprathermal electrons would probably result in a sheath formation at the boundaries of the heating region, which would appreciably alter the incoming flux. The other major effect is the return of suprathermal electrons to the heating region. Such particles have an extremely long mean free path and in certain geometries will very likely be heated many times. Inclusion of these effects should lead to a considerably more realistic simulation model. (auth)

1443 (UCRL-74106) PERTURBED ORBIT THEORY AND NUMERICAL SIMULATIONS OF PARAMETRIC HEATING. DeGroot, J.; Katz, J.; Weinstock, J.; Faehl, R.; Kruer, W. (California Univ., Livermore. Lawrence Livermore Lab.). 25 Oct 1972. 8p. (CONF-721132-4). Dep. NTIS $3.00.

From plasma physics meeting of the American Physical Society; Monterey, California, USA (13 Nov 1972).

The case $\eta \lesssim 1$ ($\eta = E_0/\sqrt{4\pi nkTe_0}$) for laser fusion is investigated. It was shown that for this case the electron heating results in the production of extensive suprathermal tails. It is shown that the dominant part of this heating is due to diffusion in velocity space. (MOW)

1444 (UCRL-741114(Rev.)) COMPUTER CALCULATIONS OF LASER-DRIVEN IMPLOSION OF SPHERICAL PELLETS OF

DT. Thiessen, A. R.; Zimmerman, G. B.; Wood, L. L.; Nuckolls, J. H. (California Univ., Livermore. Lawrence Livermore Lab.). *19 Jan 1973. 7p. (CONF-721132-8). Dep. NTIS $3.00.*

From plasma physics meeting of the American Physical Society; Monterey, California, USA (13 Nov 1972).

The LASNEX computer program has been used to make calculations of the compression and thermonuclear burn of a 60 μg uniform, homogeneous spherical pellet of DT under various assumptions concerning the distribution in energy of electrons responding to the impinging laser light. Most calculations employed *a shaped laser pulse of wavelength 1μ and energy ~60kJ. In addition,* a pellet seeded with a small amount of high-Z material (~0.1 at. %) added to enhance inverse bremsstrahlung absorption *and to increase the instability threshold, was irradiated with* shaped laser pulses of wavelengths 1 and 0.2 μ. (auth)

1445 (UCRL-74116) LASER IMPLOSION OF DT TO DENSITIES >1000 g/cm^3: OPTIMISM PULSE SHAPE; FUSION YIELD VS LASER ENERGY. Nuckolls, J.; Wood, L.; Thiessen, *A.; Zimmerman, G. (California Univ., Livermore. Lawrence* Livermore Lab.). 26 Oct 1972. 10p. (CONF-721132-7). Dep. NTIS $3.00.

From plasma physics meeting of the American Physical Society; Monterey, California, USA (13 Nov 1972).

In laser compression of DT to densities greater than 1000 g/cm^3, followed by thermonuclear ignition and efficient burn, the optimum pulse shape is determined by considerations of entropy and Fermi degeneracy, hydrodynamics and Rayleigh-Taylor instability, and thermonuclear ignition and self-heating. The required implosion symmetry is achieved by irradiating the pellet from all sides by multiple laser beams as well as by electron transport in the atmosphere ablated from the pellet. Taylor instability is suppressed by sufficiently rapid implosion as well as by generating the implosion pressure by subsonic ablation driven by diffusive electron transport. The thermonuclear yield is determined by considerations of inertia, $\bar{\sigma}\bar{V}$, density, depletion, thermonuclear self-heating, and ignition, degeneracy, implosion efficiency, and laser energy. The optimum pulse shape and thermonuclear yields are investigated. (MOW)

1446 (UCRL-74621) PLASMA CONFINEMENT AND HEATING IN THE LIVERMORE SUPERCONDUCTING LEVITRON. Hartman, C. W.; Anderson, O. A.; Birdsall, D. H.; Hooper, E. B. Jr.; Munger, R. H. (California Univ., Livermore. Lawrence Livermore Lab.). 8 Mar 1973. 6p. (CONF-730315-3). Dep. NTIS $3.00.

From third international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

Stable confinement of approximately isotropic hot-electron plasma is observed for $\beta \lesssim 0.1$ and $\beta_\phi = \beta B^2/B_\phi^2 \lesssim 10$. Confinement at large β_ϕ without anomalous loss is found to result from a cold-plasma background with $n_{ec}/n_{eh} \simeq 10$ to 10^2. Heating of dense plasma ($n_{ed} \simeq 10^{11}$ to 5×10^{12}, $T_{ed} \simeq 10$ to 20 eV) occurs by thermalization with the hot-electron plasma at a collision-determined rate without significant anomalous loss of hot electrons. (auth)

1447 EFFICIENCY OF THE MICROWAVE ENERGY ABSORPTION IN A PLASMA AT HIGH MAGNETIC FIELDS. Musil, J.; Zacek, F.; Budnikov, V. N. (Inst. of Plasma Physics, Prague). Czech. J. Phys.; 23: No. 2, 167-170(1973).

It was shown experimentally that the efficiency of the microwave energy absorption in an inhomogeneous magnetoactive plasma strongly depends on the polarization of electromagnetic waves entering the plasma. At high magnetic fields satisfying the condition $\omega_{ce}/\omega > 1$, the RHCP wave (right-hand circularly polarized wave) is absorbed most effectively; here ω_{ce} and ω are the electron cyclotron frequency and the angular frequency of an electromagnetic wave, respectively. The experimental results are in a good qualitative agreement with theory. (auth)

1448 NOTE ON THE HEATING OF MAGNETOPLASMA BY MAGNETIC PERTURBATIONS. Khosa, P. N.; Shukla, P. K.; Singh, R. N. (Banaras Hindu Univ., India). Lett. Nuovo Cim.; 6: No. 11, 433-435(17 Mar 1973).

A brief theoretical analysis of the heating is presented. The Boltzmann equation in the guiding center approximation is analyzed. Electron temperature equations are obtained from the Boltzmann equation for a homogeneous plasma. (MOW)

1449 ANOMALOUS HEATING AND MOMENTUM TRANSFER IN WEAKLY TURBULENT PLASMAS. Caponi, M. Z. College Park, MD; Univ. of Maryland (1972). 185p. University Microfilms Order No. 7 3-9683.

Thesis (Ph. D.).

Coupled kinetic equations for the density of plasmons $N_k(t)$ and spatially averaged distribution function $f_j(\underline{v},t)$ are discussed in the electrostatic approximation for weakly turbulent, unmagnetized plasmas. The equations are generalized to include resonance broadening effects due to (statistical) perturbations in the particle *orbits by the field fluctuations. The kinetic equations for* $f_j(\underline{v},t)$, describe the self-consistent reaction of the particle distributions to changes in $N_k(t)$ produced by collective effects. Discrete *particle collisions and* $O(N_k^2)$ *contributions to the kinetic equations* are neglected in the description. By taking appropriate velocity moments of the kinetic equations for the particles, rate equations for the changes in mean velocity $V_j(t)$ and kinetic energy relative to the mean $K_j(t)$ associated with the j-th component spatially averaged distribution function are derived. *The resulting rate equations* describe the bulk features of the reaction of the particle distributions (e.g., acceleration and heating rates) to collective interac*tions. The moment equations include resonant linear wave-parti*cle interactions (linear Landau damping), resonant nonlinear wave-particle interactions (nonlinear Landau damping), resonant three-wave interactions and nonresonant contributions from each of these processes. (MOW)

1450 LASER CONCENTRIC CONDUCTION HEATING OF TWO-TEMPERATURE D-T PLASMA. Kaliski, S. (Inst. of *Fundamental Technological Research, Warsaw). Bull. Acad. Pol.* Sci., Ser. Sci. Tech.; 21: No. 1, 45-51(1973).

Consideration is given to the problem of laser concentric conduction heating of D-T plasma. *Making certain simplifying as*sumptions, an asymptotic closed-form solution of the problem is obtained for the initial phase of penetration of thermal waves into plasma and for the wave front near the center of the ball. This enables estimation of the degree of concentric thermal cumulation of plasma. *Simple solutions of this type cannot be obtained if some* simplifications are not applied and if the heat of recovery of nuclear fusion energy is taken into account. Then the asymptotic *solutions lead to algebraic structures, and the general solutions* require numerical integration (with the use of analog computers). (auth)

Diagnostics

1451 (CEA-CONF-2166) TEN-CHANNEL MICROWAVE INTERFEROMETER FOR ELECTRON DENSITY MEASUREMENTS IN TFR TOKAMAK. Crenn, J. P. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). 1972. 6p. (CONF-721058-2). Dep. NTIS (U. S. Sales Only) $3.00.

From seventh symposium on fusion technology; Grenoble, France (24 Oct 1972).

A ten-channel microwave interferometer is currently being constructed at Fontenay-aux-Roses in view of measuring the spatial distribution of the electron density in the Tokamak T.F.R. The ten channels will be vertical and regularly arranged in a section of the plasma column. Each channel will provide a measurement of the microwave phase shift corresponding to the crossing of the plasma column. In this way, the spatial distribution of the electron density may be deduced by inversion of the Abel integral. The measured densities lie between 10^{12} and 5×10^{13} cm^{-3}, the microwave frequency varying between 140 and 300 GHz, depending upon the value of the density. At such frequencies it is preferable to use microwave components built with oversize waveguides. The associated electronics will enable the so-called zebra stripes to be displayed on an oscilloscope and the phase shifts to be obtained independently of the amplitude of the wave. (FR)

1452 (EUR-CEA-FC-670) STUDY OF THE OPERATION AND APPLICATIONS OF A HYDROCYANIC ACID GAS LASER. Lesieur, J. P. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Nov 1972. 103p. (In French). Dep. NTIS (U. S. Sales Only) $7.25.

Thesis. Submitted to Paris Univ., Orsay (France).

The operation of an HCN laser was studied in view of its utilization for interferometric measurements in a Tokamak machine being constructed at Fontenay-aux-Roses. The HCN laser provides a coherent 337-μ beam useful for diagnostics in machines having electron densities between 10^{13} and 10^{14} cm^{-3}. The laser cavity is described. The beam is extracted by a partially reflecting mirror inside the cavity. This mirror totally polarizes the laser beam. The laser power is optimized by controlling the cavity discharge parameters. About 30 mW of laser power is extracted. A fall in power of only 20% is observed after 3 hours operation, the discharge tube remaining uncontaminated. The modes of oscillation of the cavity were studied. (FR)

1453 (EUR-CEA-FC-681) MEASUREMENT OF THE X-RADIATION EMITTED BY THE PLASMA IN THE CIRCE EXPERIMENT. Bardet, R. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Jan 1973. 43p. (In French). Dep. NTIS (U. S. Sales Only) $4.25.

An attempt was made to determine the electron temperature of the CIRCE-experiment plasma from the continuous x-ray spectrum obtained from a scintillator–photomultiplier system provided with a memory pulse-height analyzer. The physical conditions responsible for the emitted x radiation are examined. The characteristics of the detection device were determined. (FR)

1454 CHARACTERISTICS OF TWIN PROBE IN A MAGNETIZED PLASMA. Watanabe, Y.; Akazaki, M. (Kyushu Univ., Fukuoka). Denki Gakkai Ronbunshi, A; 92: No. 3, 146-153(Mar 1972). (In Japanese).

Experiment was carried out to investigate characteristics of twin probes in magnetized plasma. Two kinds of twin probes were designed. One was a disc-type probe and the other a cylindrical probe. Both types were inserted into magnetic fields parallel with the magnetic lines of force. Sounding-probe (SP) current and reference-probe (RP) current were obtained as the functions of RP voltage. Variation of electron and ion current peaks with increase in magnetic field was also measured. Results of the experiment were analyzed. Spatial potential distribution was calculated, and the current peaks in the sounding probes were investigated. When the magnetic field was applied, the potential at a point of the electron peak was lower than the spatial potential. Transfer of the peak point became larger with the increase of the magnetic field. (JA)

1455 NEUTRAL ATOM DIAGNOSTICS OF A TURBULENTLY HEATED PLASMA. Robertson, S. H. Ithaca, NY; Cornell Univ. (1972). 151p. University Microfilms Order No. 73-10,134.

Thesis (Ph. D.).

The turbulent heating of a hydrogen plasma in a magnetic mirror device has been studied with special emphasis on the application of neutral-atom diagnostic techniques. The study was done on the Cornell Turbulent Heating Machine in which a classically confined plasma having a density of order 10^{13} cm^{-3} and a temperature of order 10^3 eV is obtained. The isotropy and the energy dependence of the flux of charge exchange neutrals emitted by the plasma column is investigated by means of a stripping analyzer. A theoretical model is presented which predicts a simple numerical relationship between the energy dependence of the neutral atom flux and that of the ion energy distribution function. The results of several experimental tests of the model are examined in which the effects of finite Larmor radii and ion drifts are investigated. The use of a beam of neutral atoms as a plasma density probe is described. The degree of attenuation of H and Ar beams is calculated from the electron impact ionization and charge exchange collision cross sections. The beam probe is used to determine the initial density of the plasma column and the time dependence of the density following turbulent heating. The turbulent heating is investigated at a higher level of applied current than used in previous studies on the Cornell device. An upper bound is found to the energy content of the plasma contained after heating. For currents just above the threshold value for the appearance of the instability the upper bound is due to a dynamic balance between the energy dissipated in the plasma and that lost at the anode. At currents of several times the threshold value the energy transferred is limited temporally by the self-quenching of the instability. These results are compared to those of other authors and to plasma theory. The design of the stripping analyzer and the neutral beam source are given and the analyzer calibration technique is described. (Diss. Abstr. Int., B)

Kinetics (General)

Refer also to abstract 1525.

1456 (IAE-2201) TOWARD A THEORY OF A TUBULAR MULTIPLE-LENS ACCELERATOR OF CHARGED PARTICLES. Morozov, A. I. (Institut Atomnoi Energii, Moscow (USSR)). 1972. 28p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.50.

In order to obtain a large particle current in ion accelerators it is necessary to compensate the space charge of the ions with electrons. It is necessary to have in the channel a transverse magnetic field so as not to destroy the electric field in the beam. The simplest system of this type, serving for the acceleration of the high-current compensated ion beam, is the tubular accelerator with alternating radial components of the magnetic field. The geometry of the field and the particle dynamics are analyzed in different models of such an accelerator. (tr-auth)

1457 (NP-19712) FAST-ELECTRON FORMATION IN THE ELECTRON-CYCLOTRON-GENERATED PLASMA NEAR THE HARMONICS OF THE ELECTRON CYCLOTRON FREQUENCY. Budnikov, V. N.; Galaktionov, B. V.; Novik, K. M.; Obukhov, A. A.; Fedorov, V. I. (Akademiya Nauk SSSR, Leningrad. Fiziko-Tekhnicheskii Institut). 1973. 27p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

The effect of plasma spreading along the magnetic field was observed in the electron cyclotron generated plasma under the condition $\omega = S\omega_{He}$ (ω is the operating frequency, $\omega_{He} = eH/mC$; $S \geq 2$ is an integer). This effect is accounted for by the presence of 500-eV fast electrons created in the absorption region of the super-high-frequency waves. These electrons propagate from the formation region along the magnetic field and produce secondary plasma by a neutral gas ionization. Fast electron cyclotrons are formed as a result of the acceleration on the electron cyclotron frequency harmonics under the action of the slow plasma waves. (auth)

1458 ACCELERATION OF ELECTRONS IN THE SLOW-WAVE FIELD OF A PLASMA WAVEGUIDE. Egorov, A. M.; Fainberg, Ya. B.; Kurilko, V. I.; Kivshik, A. F.; Bolotin, L. I.; Bats, A. F. At. Energ. (USSR); 34: No. 3, 181-184(Mar 1973). (In Russian).

Electron beam interaction with the slow wave field of limited amplitude in an anisotropic plasma waveguide is studied. The capture of injected beam particles in this waveguide was observed. The dependence of the main beam parameters of captured particles on plasma characteristics was measured. For the injection energy $W_{inj} = 10$ keV and $I_{inj} = 3$ A when $v_{ph} = \text{const} < C$, accelerated electrons of average energy $W_{acc} = 100$ keV and current $I_{acc} = 0.5$ A were obtained. It is shown that the dependence of the accelerated beam current, average energy, and energy spectrum width on the value of wave phase velocity and uhf power level agrees well with the theory. (auth)

Kinetics (Experimental)

1459 ION DYNAMICS IN A PERPENDICULAR COLLISIONLESS SHOCK. Cairns, R. A.; Sherwell, D. (Univ. of St. Andrews, Scotland). Phys. Lett.; 43A: 313-314(12 Mar 1973).

The behavior of ions moving in fields modeling those of a perpendicular shock in a collisionless plasma was investigated. The main result is that heating in excess of the adiabatic level can be produced, even in the absence of any dissipative mechanism. (auth)

Kinetics (Theoretical)

Refer also to abstract 1464.

1460 (COO-3577-3) DYNAMICS OF EXPANDING PLASMAS. Albritton, J. R. (Yale Univ., New Haven, Conn. Dept. of Engineering and Applied Science). 1972. 216p. Dep. NTIS $13.00.

Thesis.

The following topics are described in detail: (1) the snowplow model, (2) the smooth motions of snowplow model interfaces, (3) the perturbed motions of planar snowplow model interfaces, (4) reduced descriptions of the lowest interface, and (5) internal surface stress in the lowest order snowplow. (MOW)

1461 TRUNCATION TECHNIQUE FOR THE REAL TIME TWO-PARTICLE GREEN FUNCTION HIERARCHY. Lee, R. W. (Imperial Coll. of Science and Tech., London). J. Phys., B (London); 6: No. 3, 406-416(Mar 1973).

A truncation technique for the real time two-particle Green function is presented. The formalism is applied to the study of spectral line broadening in plasmas and the electron correlations are explicitly included. The relationship of the present theory to other Green function methods is discussed. Lastly, the present method is compared to two other truncation procedures which have been used to analyse spectral line broadening in plasmas. (auth)

1462 SURFACES OF DISCONTINUITY IN PLASMA PHYSICS. Mattei, G. (Politecnico, Turin). Ann. Scu. Norm. Super. Pisa, Sci. Fis. Mat.; 26: No. 2, 437-461(1972). (In Italian).

Within the framework of the nonlinear and nonsteady equations, the surfaces of discontinuity are studied in: (i) a plasma considered as a continuous medium in the magnetofluiddynamic description, and (ii) a collisionless anisotropic plasma. A detailed account is given of the surfaces of weak discontinuity whether they are wave fronts or material surfaces. The definition of weak solution is introduced for the plasmas. This definition is useful for the derivation of dynamic compatibility conditions appropriate to surfaces of strong discontinuity. (auth)

Production

Refer also to abstract 1495.

1463 ABSORPTION OF LASER LIGHT PULSE IN A DENSE PLASMA. Mehlman-Balloffet, G. (Centre National de la Recherche Scientifique, Meudon, France). J. Quant. Spectrosc. Radiative Transfer; 13: No. 5, 467-472(May 1973).

An experimental study of the absorption of a laser light pulse in a transient, high-density, high-temperature plasma is presented. The plasma is generated around a metallic anode tip by a fast capacitive discharge occurring in vacuum. The amount of transmitted light is measured for plasmas made of different metallic ions (U, Al, Be, and W) in the regions of the discharge of high electronic density. Variation of the transmission during the laser pulse is also recorded. Plasma electrons are considered responsible for the very high absorption observed. (auth)

1464 MONTE CARLO SIMULATION OF NONLINEAR RADIATION-INDUCED PLASMAS. Wang, B. S. Urbana, IL; Univ. of Illinois (1972). 131p. University Microfilms Order No. 73-10,178.

Thesis (Ph. D.).

A Monte Carlo simulation model for radiation-induced plasmas with nonlinear properties due to recombination has been developed, employing a piecewise linearized predict-correct iterative technique. Several important variance reduction techniques have been developed and incorporated into the model, including an antithetic variates technique (negatively correlated variates) which has proven to be most useful. This approach is especially efficient for plasma systems with inhomogeneous media, multidimensions, and irregular boundaries, where other analytic or numerical solutions are either unrealistic or impractical. This model is quite general in scope and should be applicable to a variety of similar particle transport and diffusion-type plasma problems. The Monte Carlo code was applied to the determination of the electron energy distribution function and related parameters for a noble gas plasma created by α-particle irradiation. The radiation-induced plasma involved was characterized by the following features: (1) a continuous internal volume-source of high-energy electrons; (2) an applied electric field (optional); (3) secondary electron production via ionization processes; and (4) losses via recombination and leakage across boundaries. (MOW)

Stability

1465 (CONF-730315-6) THERMAL STABILITY OF A MODERATELY LARGE TOKAMAK PROTO-REACTOR. Dory, R. A.; Hogan, J. T.; Widner, M. M. (Oak Ridge National Lab., Tenn.). [nd]. 4p. Dep. NTIS $3.00.

From 3rd international symposium on toroidal plasma confinement; Garching, F.R. Germany (26 Mar 1973).

An operating procedure is given, which uses feedback control of the external energy input source (injection of energetic neutral particles) to give thermally stable operation near but below the ignition temperature T_c. For higher temperatures, thermonuclear reactions give enough energy to the plasma to overbalance the energy loss mechanisms now known and (because the thermonuclear rates rise more steeply with temperature) lead to thermal runaway. A previously developed space (minor radius r) and time resolved computer code is used to follow the evolution of a single discharge, incorporating the toroidal ion energy transport coefficients (''neoclassical'') given by Galeev and Sagdeev. Electron thermal transport is assumed to follow the law proposed by Artsimovich. Synchrotron radiation following Trubnikov is included, and bremsstrahlung losses and electron-ion energy transfer after Spitzer. The data are described. (MOW)

1466 (EUR-CEA-FC-649) STABILITY OF A CIRCULAR TOROIDAL TOKAMAK TYPE PLASMA. Declerco, G. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Jul 1972. 41p. (In French). Dep. NTIS (U. S. Sales Only) $4.25.

Study of the stability of a circular-cross-section toroidal plasma developed by A. A. Ware and F. A. Haas in 1965 was reconsidered and completed, the $m \ll a/R$ condition concerning the modes being suppressed. The $dp/dr(1 - q^2) > 0$ relation was used in the delta-W expression as a sufficient stability condition. (FR)

1467 (MATT-960) PARAMETRIC DECAY NEAR THE LOWER HYBRID RESONANCE. Fidone, I. (Princeton Univ., N. J. Plasma Physics Lab). Apr 1973. Contract AT(11-1)-3073. 8p. Dep. NTIS $3.00.

Spatial parametric decay of a wave with frequency near the lower hybrid frequency is investigated. A three-waves problem is considered with special emphasis on the effect of the mismatch of the wave vectors on the saturation amplitude of the excited waves and the characteristic length of conversion. (auth)

1468 (MATT-976) STABILITY OF THE ELLIPTICAL CROSS SECTION FOR A FREE-BOUNDARY TOKAMAK. Rutherford, P. H. (Princeton Univ., N. J. Plasma Physics Lab). Apr 1973. Contract AT(11-1)-3073. 13p. Dep. NTIS $3.00.

Analyzing stability of the free-boundary cylindrical tokamak of elliptical cross section with semi-axes a, b to modes with $k = 0$, instability to vertical displacement ($m = 1$) is shown if $b > a$, and to triangulation ($m = 3$) if $b/a > 4.5$, but stability to $m = 2,4$ for any b/a. (auth)

1469 (NP-19716) NONSTATIONARY THEORY OF DECAY INSTABILITY IN WEAKLY INHOMOGENEOUS PLASMA. Piliya, A. D. (Akademiya Nauk SSSR, Leningrad. Fiziko Tekhnicheskii Institut). 1973. 19p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The time evolution of the amplitudes of two parametrically coupled waves in a weakly inhomogeneous plasma is considered for the case when the oscillations can be described by the WKB approximation and the decay conditions are satisfied only in a single resonant plane of the layer. Conditions for existence of a stationary solution are found. They are determined by the imaginary part of the product of the matrix elements of the wave interaction. (auth)

1470 (UCRL-74103) TURBULENT ELECTRON COUPLING DUE TO TWO STREAMING INSTABILITIES DRIVEN BY A SPATIALLY NONUNIFORM TEMPERATURE PROFILE. Lindl, J. D.; DeGroot, J. S. (California Univ., Livermore. Lawrence Livermore Lab.). 25 Oct 1972. 6p. (CONF-721132-6). Dep. NTIS $3.00.

From plasma physics meeting of the American Physical Society; Monterey, California, USA (13 Nov 1972).

Two questions are considered: (1) At a given position, does the two-stream instability have time to be established? The minimum velocity required for a particle to reach position X is $V_{min} = X/t$. The time that a wave will be unstable is given by the time it takes for V_{min} to pass below the wave phase velocity or $V_{min} = V_p = X/t_{max}$. t_{max} must be several growth times for the wave if the electric field is to grow to levels that can significantly affect the distribution of particles. (2) What are the nonlinear effects of the two streaming instability on the particle distribution? A 1-D electrostatic cloud-in-cell plasma simulation code is used in the analysis. Some features of the code are shown. The code looks at a section of plasma, typically 4096 λ_D in length. On the left boundary, particles are reflected and the electric field there is set equal to zero. This boundary condition on the electric field is valid until particles injected from the right have had time to cross the system. On the right hand boundary, the plasma is considered to be in contact with plasma at the same temperature so that particles flow into and out of the plasma at this end at a thermal equilibrium rate. Some of the results of work with this code are shown for a run in which $T_h/T_c = 25$ and $l = 100\ \mu$. (MOW)

1471 ION ACOUSTIC INSTABILITY IN THE HELIUM POSITIVE COLUMN. Fenneman, D. B. Urbana, IL; Univ. of Illinois (1972). 107p. University Microfilms Order No. 73-9925.

Thesis (Ph. D.).

The theory of ion acoustic instability of the helium positive column in the pressure regime 0.050 to 0.250 torr is developed, examined, and tested experimentally. Instability of the column is predicted by a kinetic theory which includes the effect of collisions with neutrals, but not by hydrodynamic theory. In the regime of the experiment, the ion acoustic instability is due to the resonant interaction of those electrons with velocities near the phase velocities of the ion acoustic waves (inverse Landau damping) even though the electron-neutral collision frequency exceeds the ion acoustic frequency. The detection of the spontaneously arising waves is found to be crucially dependent on the bias of the detecting probe. The problem of discrimination of ion acoustic waves from other oscillations arising in the column at similar frequencies is discussed. The spectral properties, onset characteristics, spatial distribution and saturation intensity are measured and compared with theoretical predictions. (Diss. Abstr. Int., B)

1472 EQUILIBRIUM AND STABILITY THEORY OF LARGE-AMPLITUDE SPATIALLY PERIODIC TRANSVERSE ELECTROMAGNETIC WAVES IN PLASMAS. Berger, R. L. College Park, MD; Univ. of Maryland (1972). 164p. University Microfilms Order No. 73-9675.

Thesis (Ph. D.).

The stability of transverse magnetic Bernstein-Greene-Kruskal waves to small-amplitude perturbations is analyzed within the framework of the Vlasov-Maxwell equations. The Vlasov-Maxwell equations are linearized about an equilibrium state which supports (self-consistently) a spatially periodic finite-amplitude transverse electromagnetic wave. An external magnetic field, $\underline{B}_0 = B_0\hat{e}_z$, is included in the analysis, and spatial variations in equilibrium and perturbed quantities are taken to be in the z direction. A matrix dispersion equation is obtained that relates the

(complex) oscillation frequency ω and wave number k of the perturbation; for the case of a purely sinusoidal circularly-polarized equilibrium wave, the dispersion relation reduces to an equivalent 3×3 matrix that links an electrostatic wave of a wave number k and frequency ω, a right circularly polarized transverse wave of wave number $k - k_0$ and frequency ω, and a left circularly polarized wave of wave number $k + k_0$ and frequency ω, where ω and k are the wave frame values. Several examples are considered for both $B_0 = 0$ and $B_0 \neq 0$. (MOW)

1473 HELICAL INSTABILITY OF A PLASMA FILAMENT OF ELLIPTICAL CROSS SECTION. Solov'ev, L. S. At. Energ. (USSR); 34: No. 3, 207-209(Mar 1973). (In Russian).

The conditions for hydromagnetic stability for a plasma column of elliptical cross section are investigated theoretically. Spiral excitation for cases of uniform surface current are taken into account. (KSW)

1474 SYMMETRY PROPERTIES IN A TWO-STREAM ELECTROSTATIC INSTABILITY. Seshadri, S. R. (Univ. of Wisconsin, Madison). Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 1, 139-140(Jan 1973).

A double stream consisting of immobile ions and mobile electrons which is partly drifting and partly stationary is considered. Certain symmetry properties of the dispersion relation of the longitudinal plasma wave having its wave vector parallel to the direction of the electron stream are discussed. These symmetry properties enable the results for a particular value of the relative number density of the streaming electrons to be deduced from the corresponding results for the same value of the relative number density for the stationary electrons. (auth)

Thermonuclear Engineering and Equipment

1475 (CEA-CONF-2174) SOME CONSIDERATIONS ON A THERMONUCLEAR REACTOR. Breton, D. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). 1972. 11p. (CONF-720912-4). Dep. NTIS (U. S. Sales Only) $3.00.

From international school on fusion reactor technology; Erice, Italy (4 Sep 1972).

Some of the main problems which could be raised by the production of thermonuclear energy in a toroidal device of the tokamak-type are considered. Some general characteristics of a tokamak reactor are outlined. The following problems are briefly discussed: (1) first wall, (2) magnetic confinement, (3) breeding ratio and tritium cycle, (4) heat removal, (5) radiation damage and shielding problems, and (6) refueling and extraction of ashes. (MOW)

1476 (CEA-R-4365) DEVELOPMENT AND PERFORMANCE OF A DOUBLE DIAPHRAGM SHOCK TUBE. Leboucher, J. C. (Commissariat a l'Energie Atomique, Vaujours (France). Centre d'Etudes). Feb 1973. 108p. (In French). Dep. NTIS (U. S. Sales Only) $7.50.

Thesis. Submitted to Paris Univ. (France).

The theoretical and experimental performances were compared, argon being used as the test gas. In this way, it was shown that shock waves having velocities as high as 15 km/s could be produced. Various diagnostic techniques were employed to measure the velocity of the wave front and its attenuation, as well as the thickness of the gas heated by the shock (expressed generally by the test time, τ, at a given point). An estimation of the temperature and electron number density of the plasma behind the shock was effected spectroscopically. The experimental results obtained confirm theoretical predictions. It is shown that the velocity gain of T. C. D. 2 over a simple shock tube may be as high as 60%. (auth)

1477 (CONF-721111-29) SIMPLIFIED PARAMETRIC STUDY OF TOKAMAK FUSION REACTORS. Hatch, A. J.; Etzweiler, J. (Argonne National Lab., Ill.). [nd]. 21p. Dep. NTIS $3.25.

From international meeting on the technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors; Austin, Texas, USA (20 Nov 1972).

Computation of the design parameters of tokamak fusion reactors on the basis of the model of Golovin et al. was simplified by establishing a hierarchy of independent reactor parameters based on their permissible ranges of values. The wide-range parameters are the first-wall loading P_w and the blanket thickness T_B. The narrow-range parameters are the poloidal β_p of the plasma and the stability coefficient q. The unvaried parameters are the ratio of plasma radius to wall radius y, the maximum toroidal magnetic field B_m, and the plasma temperature $T_e = T_i$. Computations are made through the full ranges of all the above parameters. All computations are for the optimum value of the aspect ratio A that minimizes B_m. Plots of computed values of (1) total thermal power P_T vs β_p and q for selected values of P_w and T_B, (2) P_T vs P_w and T_B for selected values of β_p and q, and (3) major radius R, wall radius r_w, and other dependent parameters vs P_w for selected values of β_p, q, and T_B will be presented for use in preliminary design studies of tokamak systems. (auth)

1478 (NP-19709) NEUTRONIC CALCULATIONS IN A SIMULATED FUSION REACTOR BLANKET. Barbee, S. G. (Texas Univ., Austin). Nov 1972. 269p.

Thesis.

The neutron flux of energies ranging from .414 eV to 14.92 MeV was calculated in a standard simulated fusion reactor blanket by the use of the neutron transport computer code ANISN. Among the quantities evaluated were the neutron flux as a function of distance into the fusion blanket for each energy group, the average flux as a function of energy for each zone of the fusion blanket, the neutron flux leaving the outer boundary of the simulated fusion blanket, the neutron absorption rate (integrated over all energies) as a function of distance into the fusion blanket, the total reaction rate (integrated over all energies) as a function of distance into the fusion blanket, and the integrated total neutron flux present in the first and second vacuum walls. An analysis of these data was followed by a list of suggestions which should enable more detailed calculations to be performed. (auth)

1479 (ORNL-TM-4177) ANALYSIS OF A BENCH-MARK CALCULATION OF TRITIUM BREEDING IN A FUSION REACTOR BLANKET: THE UNITED STATES CONTRIBUTION. Steiner, D. (Oak Ridge National Lab., Tenn.). Apr 1973. Contract W-7405-eng-26. 37p. Dep. NTIS $4.00.

A bench-mark calculation of tritium breeding in a fusion reactor blanket model was performed using ENDF/B-3 as the reference for cross-section data. The ENDF/B-3 data was processed into multigroup sets using the ETOG code (at BNL and LASL) and the SUPERTOG code (at ORNL). Calculations were performed using the discrete ordinates codes ANISN (at BNL and ORNL) and DTF-IV (at LASL) and the Monte Carlo code MORSE (at ORNL). Analysis of the calculations identified deficiencies in the processing codes and differences in calculational details that resulted in discrepancies among the calculated results. Correction of these deficiencies and a more precise specification of calculational details will lead to improved agreement in future fusion benchmark problems. (auth)

1480 (UCRL-74109) COMPUTER CALCULATIONS OF X-RAY PRODUCTION BY LASER-PRODUCED PLASMAS. Birkett, R. E.; Zimmerman, G. B. (California Univ., Livermore. Lawrence Livermore Lab.). 27 Oct 1972. 8p. (CONF-721132-3). Dep. NTIS $3.00.

From plasma physics meeting of the American Physical Society; Monterey, California, USA (13 Nov 1972).

A two-dimensional Lagrangian computer program, LASNEX, has been used to estimate the x-ray yield from laser-produced plasmas. The basic features of this computer program are given. The laser absorption and the radiation are discussed. The absorption mechanisms assumed are inverse bremsstrahlung and enhanced resistivity due to laser-driven plasma instabilities. The energy absorbed by each process is distributed over electron velocity groups according to a distribution function appropriate to that process. These distribution functions and the corresponding absorption coefficients are shown. (MOW)

1481 (UCRL-74110) SELF-GENERATED MAGNETIC FIELDS AND NONTHERMAL ELECTRONS IN LASER-PRODUCED PLASMAS: SIMULATION TECHNIQUES AND CALCULATIONAL RESULTS. Zimmerman, G. B.; Scharleman, E. T.; Wood, L. L. (California Univ., Livermore. Lawrence Livermore Lab.). 27 Oct 1972. 7p. (CONF-721132-9). Dep. NTIS $3.00.

From plasma physics meeting of the American Physical Society; Monterey, California, USA (13 Nov 1972).

The following are presented: (1) a review of the plasma interactions important to laser fusion with a description of the approximations LASNEX uses to model these interactions; (2) a more detailed treatment of the suprathermal electron scheme employed; and (3) a discussion of the MHD equations as modeled in LASNEX. (MOW)

1482 POSSIBILITY OF MICROFISSION EXPLOSIONS BY LASER OR RELATIVISTIC ELECTRON-BEAM HIGH-DENSITY COMPRESSION. Winterberg, F. (Univ. of Nevada System, Las Vegas). Lett. Nuovo Cim.; 6: No. 11, 407-411(17 Mar 1973).

Implosion techniques for reducing the critical mass of a fissionable assembly to such a degree that a fission microexplosion can occur are discussed. Critical masses with and without neutron reflectors are described. (MOW)

1483 EXACT EIGENVALUE OF AXIALLY SYMMETRIC SURFACE WAVE IN A CYLINDRICAL CAVITY WITH A MAG-

NETIZED PLASMA. Ikezawa, S.; Okuda, T.; Tanaka, Y.; Ohguchi, Y. (Nagoya Univ., Japan). Denki Gakkai Ronbunshi, A; 92: No. 1, 9-17(Jan 1972). (In Japanese).

Axial surface waves in a cylindrical cavity with magnetized plasma were investigated theoretically and experimentally. Theoretical calculation was performed for the cylindrical cavity containing magnetized cylindrical plasma, in which mode of the surface waves was restricted to axial symmetry. Field patterns were studied with the consideration of glass thickness. Effect of elastic collision was also studied. Exact eigenvalues approached quasi-static eigenvalues in the region of low density and showed departure from the quasi-static eigenvalues in the region of high density. Phase velocity approached light velocity in the high-density region. The eigenvalues moved to the low-density side when the magnetic field was increased. In the experiment, electron density was observed with a Langmuir probe installed at the surface and the center of the plasma cylinder. The observed values were in agreement with the calculated values within 10% error. TE and TM waves transferred to TEM waves in the cases of high densities. (JA)

1484 PARAMETERS OF STRAIGHT POLOIDAL HELIOTRON FIELD. Uo, K. (Kyoto Univ.). Denki Gakkai Ronbunshi, A; 92: No. 4, 199-205(Apr 1972). (In Japanese).

Parameters of a straight polloidal heliotron field, which can vary the magnetic field, were determined. The straight poloidal heliotron field is equivalent qualitatively to the field made by inserting a negative coil of a heliotron-B type field into the plasma. Configuration of the field is determined by the combination of ratio λ of the magnetic field made by the ring current and external field, the ratio τ of radius of ring conductors and the interval of their arrangement. For the infinite poloidal heliotron field, studies were carried out for the following values of the parameter λ; $\lambda \to -\infty$, $\lambda < \lambda_1 < 0$, $\lambda = \lambda_1 < 0$, $\lambda_1 < \lambda < \lambda_0 < 0$, $\lambda = \lambda_0 < 0$, $\lambda_0 < \lambda < 0$, $\lambda = 0$, $\lambda > 0$, and $\lambda \to \infty$, where λ_0 and λ_1 are given as follows, $(1/\lambda_0) = -\Sigma_{\nu=-\infty}^{\infty}[1/(1+\nu^2\tau^2)^{3/2}]$, $(1/\lambda_1) = -\Sigma_{\nu=-\infty}^{\infty}\{1/[1+(\tau^2/4)(1-2\nu)^2]^{3/2}\}$. Obtained fields are shown in figures. Results for the poloidal heliotron field with one ring conductor were equivalent to results of the above-mentioned field for $\tau \to \infty$. Studies were made for $\lambda = -\infty$, $\lambda < \lambda_{10} < 0$, $\lambda = \lambda_{10} < 0$, $-1 < \lambda < 0$, $\lambda = 0$, $\lambda > 0$ and $\lambda \to \infty$, where λ_{10} is -1, and results are also shown in figures. The poloidal heliotron field with two ring conductors was also investigated. Results for the various values of λ are shown in figures. (JA)

1485 USE OF A LUMPED-CONSTANT TRANSMISSION LINE AS THE ENERGY STORAGE SYSTEM FOR A CROSSED-FIELD PLASMA SOURCE AND THE RESULTING ENERGY DISTRIBUTION AND IMPURITY CONTENT OF THE DOWN-STREAM PLASMA. Baker, C. C. Madison, WI; Univ. of Wisconsin (1972). 157p. University Microfilms Order No. 72-33,839.

Thesis (Ph. D.).

A 2.5-μF lumped-constant transmission line was designed and used as the energy storage system in an effort to eliminate the problem of internal shorting. In order to provide adequate impedance matching, it was necessary to operate in a gas-starved manner with a time delay between firing the gas valve and applying the high voltage of 240 μsec. Increasing the time delay to 365 μsec resulted in an increased capacitance of the source, which made impedance matching impossible. In this mode the oscillating voltage and current were 90° out-of-phase and only a small portion of the stored energy was delivered to the source during the first pulse. (MOW)

1486 CHEMISTRY OF FUSION TECHNOLOGY. Proceedings of a Symposium Held in Boston, Massachusetts, April 12, 1972. Gruen, D. M. (ed.). New York; Plenum Publishing Corporation (1972). 406p. (CONF-720472–). $19.50.

From symposium on the chemistry of fusion technology; Boston, Massachusetts, USA (12 Apr 1972).

Separate abstracts were prepared for the 10 papers included here. (MOW)

For abstracts of individual papers see: 1435 and 1487–1495.

1487 TRITIUM BREEDING AND DIRECT ENERGY CONVERSION. Lee. J. D. (Univ. of California, Livermore). pp 51-90 of Chemistry of Fusion Technology. Gruen, D. M. (ed.). New York; Plenum Publishing Corp. (1972).

From symposium on the chemistry of fusion technology; Boston, Massachusetts, USA (12 Apr 1972). See CONF-720472–.

Tritium breeding and direct energy conversion are key technological problems in the development of practical fusion reactors. Lithium in some form is needed for tritium generation, but certain chemical problems must be overcome. Alternatives to lithium metal should be considered. Better methods must be developed for efficiently recovering the tritium and safely disposing of the unwanted byproducts. Separation of the fusion fuel and waste products will be especially challenging for mirror machines with direct energy conversion. Hopefully, in the long run, these machines will employ the D–^{3}He fuel cycle, but this will impose additional demands for efficient helium isotope separation and, possibly, tritium storage in some manner that allows for recovery of the ^{3}He decay product. (auth)

1488 REVIEW OF CHEMICAL, PHYSICAL, AND THERMAL PROPERTIES OF LITHIUM RELATED TO ITS USE IN FUSION REACTORS. Cairns, E. J.; Cafasso, F. A.; Maroni, V. A. (Argonne National Lab., IL). pp 91-160 of Chemistry of Fusion Technology. Gruen, D. M. (ed.). New York; Plenum Publishing Corp. (1972).

From symposium on the chemistry of fusion technology; Boston, Massachusetts, USA (12 Apr 1972). See CONF-720472–.

The successful use of any material as a blanket or as a coolant in fusion reactors will depend on a very large number of properties, thermodynamic, physical, chemical, and otherwise. A number of important properties of lithium that pertain to its use as a blanket and/or coolant in a D-T fusion power plant are reviewed. Among the topics covered are natural abundance, thermodynamic and transport properties, characterization, analysis, control of species in lithium, and corrosion of materials (including electronic insulators) by molten lithium. Throughout this review an attempt was made to indicate the importance of the individual properties as they would affect the overall design considerations of an operating reactor and to point out areas where information is lacking and where additional work is needed. (auth)

1489 MOLTEN SALTS AS BLANKET FLUIDS IN CONTROLLED-FUSION REACTORS. Grimes, W. R.; Cantor, S. (Oak Ridge National Lab., TN). pp 161-190 of Chemistry of Fusion Technology. Gruen, D. M. (ed.). New York; Plenum Publishing Corp. (1972).

From symposium on the chemistry of fusion technology; Boston, Massachusetts, USA (12 Apr 1972). See CONF-720472–.

The blanket of a fusion reactor serves to absorb and transfer the energy of the fusion reaction products, and to produce the tritium necessary to refuel the reactor. This report outlines how these two functions are performed by lithium-bearing molten salts. (auth)

1490 FUSION-REACTOR FUEL PROCESSING. Johnson, E. F. (Princeton Univ., NJ). AT(11-1)-3073. pp 191-214 of Chemistry of Fusion Technology. Gruen, D. M. (ed.). New York; Plenum Publishing Corp. (1972).

From symposium on the chemistry of fusion technology; Boston, Massachusetts, USA (12 Apr 1972). See CONF-720472–.

For thermonuclear power reactors based on the continuous fusion of deuterium and tritium the principal fuel processing problems occur in maintaining desired compositions in the primary fuel cycled through the reactor, in the recovery of tritium bred in the blanket surrounding the reactor, and in the prevention of tritium loss to the environment. Since all fuel recycled through the reactor must be cooled to cryogenic conditions for reinjection into the reactor, cryogenic fractional distillation is a likely process for controlling the primary fuel stream composition. Another practical possibility is the permeation of the hydrogen isotopes through thin metal membranes. The removal of tritium from the ash discharged from the power system would be accomplished by chemical procedures to assure physiologically safe concentration levels. The recovery process for tritium from the breeder blanket depends on the nature of the blanket fluids. For molten lithium the only practicable possibility appears to be permeation from the liquid phase. For molten salts the process would involve stripping with inert gas followed by chemical recovery. In either case extremely low concentrations of tritium in the melts would be desirable to maintain low tritium inventories, and to minimize escape of tritium through unwanted permeation, and to avoid embrittlement of metal walls. (auth)

1491 CHEMICAL EFFECTS OF PLASMA INTERACTIONS WITH THERMONUCLEAR REACTOR SURFACES. Gruen, D. M. (Argonne National Lab., IL). pp 215-239 of Chemistry of Fusion Technology. Gruen, D. M. (ed.). New York; Plenum Publishing Corp. (1972).

From symposium on the chemistry of fusion technology; Boston, Massachusetts, USA (12 Apr 1972). See CONF-720472–.

Fusion reactor fuel processing is a critical area of reactor operation because tritium inventory and holdup are vital considerations with respect to safety and economics. Most of the tritium (and deuterium) in the fuel cycle comes directly from the plasma as the "unburned" fraction containing the helium ash. Various schemes have been proposed for thermalizing the energetic, unburned plasma fraction and preparing it for re-injection into the machine. One of these schemes, "chemical" or "reactive" trapping at metal surfaces, is discussed in detail. Requirements on trapping surfaces are examined from the point of view of trapping

efficiency as a function of surface temperature and total dose. Limitations on lifetimes imposed by various erosion processes are discussed. Chemical sputtering due to the interaction of reactive D^+ and T^+ energetic particles is discussed and the application of the matrix isolation technique to studies of sputtering rates and to the identification of sputtered products is explored. (auth)

1492 DIFFUSION AND PERMEATION OF HYDROGEN ISOTOPES IN FUSION REACTORS: A SURVEY. Stickney, R. E. (Massachusetts Inst. of Tech., Cambridge). pp 241-319 of Chemistry of Fusion Technology. Gruen, D. M. (ed.). New York; Plenum Publishing Corp. (1972).

From symposium on the chemistry of fusion technology; Boston Massachusetts, USA (12 Apr 1972). See CONF-720472-.

Conceptual designs of fusion reactors indicate that efficient containment and recovery of tritium are essential to the economics and safety of the system. The various problems associated with tritium containment and recovery are illustrated by considering a specific reactor design, and the candidate materials and estimated operating conditions are identified. The principal thermodynamic and kinetic relations for hydrogen solubility, diffusivity, and permeability are summarized, and the available experimental data for the candidate materials are surveyed. On the basis of this survey, the need for additional data is outlined. (auth)

1493 CONDENSED-PHASE METAL-HYDROGEN SYSTEMS AND THEIR ROLE IN CONTROLLED FUSION REACTORS. Libowitz, G. G. (Kennecott Copper Corp., Lexington, MA). pp 321-337 of Chemistry of Fusion Technology. Gruen, D. M. (ed.). New York; Plenum Publishing Corp. (1972).

From symposium on the chemistry of fusion technology; Boston, Massachusetts, USA (12 Apr 1972). See CONF-720472-.

The properties of metallic and saline hydrides and their corresponding deuterides and tritides of possible interest to controlled fusion reactor technology are reviewed. Topics discussed include the effect of hydrogen on the strength of structural materials, the solubilities of hydrogen and its isotopes in metals, the Li-H system, and the use of metal hydrides as hydrogen storage and shield materials. (auth)

1494 CHEMICAL ASPECTS OF NEW SUPERCONDUCTING MATERIALS AND FABRICATION TECHNIQUES. Bowman, M. G. (Los Alamos Scientific Lab., NM). pp 339-358 of Chemistry of Fusion Technology. Gruen, D. M. (ed.). New York; Plenum Publishing Corp. (1972).

From symposium on the chemistry of fusion technology; Boston, Massachusetts, USA (12 Apr 1972). See CONF-720472-.

Significant progress has been made in recent years in thermonuclear research. For continued progress leading to economically attractive fusion reactors the use of large superconducting magnets for the heating and confinement of plasmas appears to be necessary. Similarly, superconducting transmission line networks will be required for the distribution of power from large fusion reactors. For each application, the "best" superconducting material may exhibit different properties, but for both uses, the search for new and better superconducting materials and fabrication methods will be a continuing requirement. Theories of superconductivity are very successful in explaining properties of the superconducting state and the origin of superconducting electron pairs, but up to the present have been of no value in guiding the search for better superconducting materials. Progress has been made through the use of empirical correlations of normal state properties with superconducting transition temperatures. These include: average number of valence electrons per atom versus T_c; valence electron density versus T_c; lattice parameter of M-M distances (M = transition metal) versus T_c in special crystal structures; and variations of these approaches with attempts to include lattice vibration properties. Recent work has demonstrated that stoichiometry and ordering are most important and suggests that existing empirical correlations may not be useful in the search for new superconductors. New developments indicate that many high temperature superconductors will be found in complex ternary and quaternary systems. Innovations in fabrication methods promise that the highest T_c and critical field materials may soon be fabricated in the form of relatively ductile multifilament composite wires. This will contribute greatly to the application of superconducting technology in controlled thermonuclear reactors. (51 references) (auth)

1495 EXPERIMENTS LEADING TO LASER-INDUCED FUSION. Lubin, M. J. (Univ. of Rochester, NY). pp 359-384 of Chemistry of Fusion Technology. Gruen, D. M. (ed.). New York; Plenum Publishing Corp. (1972).

From symposium on the chemistry of fusion technology; Boston, Massachusetts, USA (12 Apr 1972). See CONF-720472-.

The basic requirements for energy production via controlled thermonuclear fusion are discussed. The application of high-peak power laser radiation to this problem is considered. A description of the requirements on radiation wavelength, pulse duration, and focused field strength is given with emphasis placed on a controlled fusion reactor configuration providing both ignition and containment properties. Present experimental evidence for laser fusion is reviewed and compared with theory. (auth)

Wave Phenomena

1496 (JUL-890-PP) INVESTIGATION OF THE STRUCTURE OF THE PLANE BOUNDARY LAYER BETWEEN THE MAGNETIC FIELD AND PLASMA. Repp, H. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Plasmaphysik). Oct 1972. 81p. (In German). Dep. NTIS (U. S. Sales Only).

Thesis. Submitted to Technische Hochschule, Aachen (West Germany).

The equilibrium structure of the boundary layer between a plane magnetic piston and a low-density plasma is studied for high but constant piston velocity (disregarding particle collisions and thermal velocities). Taking the piston as the resting system it is considered as a stationary reflection of a cold plasma jet impinging perpendicular to the boundary layer. The structure of the boundary layer is characterized by the electric and magnetic field strength, which are determined from Maxwell's equations and equations of motion for ions and electrons. The field strength is represented for terms of first order in a closed form; the terms of the zeroth order are smooth functions of the local variables, the terms of the first order are oscillatory functions with space dependent wavelength and amplitude. The magnetic field oscillations disappear in the plasma, the oscillations of the electric field strength are nonlinear longitudinal electrostatic plasma waves (with phase velocity equal to piston velocity). The value of the oscillation amplitude determines the excess of one kind of particle in the boundary layer. The amplitude with neutral boundary layer as well as its distance of the reflection plane is calculated as a function of the piston velocity. For high velocities (near light velocity) the oscillatory phenomena become very important, but then a relativistic treatment is necessary . (GF)

1497 (MATT-961) NONLINEAR WAVE CONVERSION AT THE LOWER HYBRID RESONANCE. Fidone, I. (Princeton Univ., N. J. Plasma Physics Lab). Apr 1973. Contract AT(11-1)-3073. 8p. Dep. NTIS $3.00.

Excitation of ion cyclotron waves by nonlinear mixing of two waves with frequencies near the lower hybrid frequency is investigated. The conversion efficiency is estimated for moderately hot plasmas and the result indicates that the process can be of practical interest. (auth)

1498 (MATT-979) LINEAR WAVE CONVERSION AT THE LOWER HYBRID RESONANCE. Fidone, I. (Princeton Univ., N. J. Plasma Physics Lab). Apr 1973. Contract AT(11-1)-3073. 8p. Dep. NTIS $3.00.

Linear wave conversion at the lower hybrid frequency is investigated. It is shown that total conversion takes place between the components of the energy flux in the direction of the density gradient. The power of the converted plasma wave is obtained in terms of the incident flux at the plasma boundary. (auth)

1499 (NP-19710) VOLUME AND SURFACE VERY-HIGH-FREQUENCY WAVES IN A PLASMA AND THEIR EXCITATION BY RELATIVISTIC ELECTRON BEAMS. Bogdankevich, L. S.; Rukhadze, A. A. (Akademiya nauk SSSR, Moscow. Fizicheskii Institut). 1973. 38p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.00.

After a formal statement of the problem of very-high-frequency oscillations in a plasma-beam system, fundamental equations and their boundary conditions are formulated. VHF electromagnetic waves in an isotropic plasma cylinder and the excitation of such waves by relativistic electron beams are next investigated. The current vector of the electromagnetic radiation (Poynting vector) and the efficiency factor of the radiator are calculated, based on the plasma-beam interaction. Results of a theoretical analysis and some practical recommendations are presented. (KSW)

1500 SINGLE-MODE INTERACTION IN A TURBULENT PLASMA-BEAM DISCHARGE. Lavrovskii, V. A.; Kharchenko, I. F.; Shustin, E. G. (Inst. of Radio Engineering and Electronics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 16: No. 11, 425-427(5 Dec 1972).

Translated from Zh. Eksp. Teor, Fiz., Pis'ma Red.; 16: No. 11, 602-605(5 Dec 1972).

The instantaneous characteristics of the hf field excited in the system were analyzed; these characteristics were measured in a time interval much shorter than the characteristic time of variation of the discharge parameter. This analysis confirmed the

applicability of the nonlinear theory of single-mode interaction. to the beam–plasma discharge. (MOW)

1501 DRIFT WAVES IN FINITE-BETA PLASMAS. Chance, M. S. Los Angeles; Univ. of California (1972). 177p. University Microfilms Order No. 73-6380.

Thesis (Ph. D.).

Recent advances in laboratory plasmas and in space have demanded a need for theoretical work in finite-beta inhomogeneous plasmas and, while extensive work has been done in the low-beta regime, very little has been done when beta is finite and, in some cases, low-beta theories are applied to finite-beta situations to give only a fair explanation of observed phenomena. The objective of this dissertation is to include some finite-beta effects in theoretical calculations applicable to collisionless inhomogeneous plasmas and to see what the ramifications are. In particular, the finite-beta effects of low-frequency drift waves are studied. The work of Mikhailovskii and Rudakov (1963) whose theory includes finite beta effects but is still restricted in values of beta much less than unity is extended to high betas. The theory of the authors mentioned above was adapted to a magnetospheric situation by Coroniti and Kennel (1970), but later observations showed that there were discrepancies in the predictions of this theory. These calculations are modified by including high-beta effects and, by doing so, it is shown that observation and theory are now quite compatible. (Diss. Abstr. Int., B)

1502 RELATIVISTIC ELECTROMAGNETIC WAVES IN PLASMAS. Max, C. E. Princeton, NJ; Princeton Univ. (1972). 135p. University Microfilms Order No. 73-9627.

Thesis (Ph. D.).

New steady-state solutions are derived which describe electromagnetic waves strong enough to make plasma ions and electrons relativistic. A two-fluid model is used throughout. The following solutions are studied in detail: (1) Circularly polarized waves in a uniform plasma characterized by a scalar pressure tensor; (2) Arbitrarily polarized waves with phase velocity near c; (3) Linearly polarized waves with phase velocity much greater than c, in a cold uniform plasma. All of these waves are capable of propagating in normally overdense plasmas, due to nonlinearities introduced by relativistic effects. The propagation of relativistically strong waves in a density gradient is examined, for the example of a circularly polarized wave strong enough to make electrons but not ions relativistic. It is shown that such a wave propagates at constant energy flux despite the nonlinearity of the sytem. However, nonlinear effects can greatly increase the maximum plasma density at which a relativistically strong wave can propagate. The second part of this work studies the stability of a circularly polarized electromagnetic wave that is strong enough to make plasma electrons but not ions relativistic. A linear stability analysis is used to derive a dispersion relation describing the growth of small perturbations, for arbitrary wavelengths of the driving wave. A relativistically strong wave is unstable on timescales as short as twice its own oscillation period, and decays into a forward-going plasma oscillation and either one or two electromagnetic waves. Ion motion introduces two modes into the system which are not present when ions are regarded as a stationary background. For a relativistically strong driving wave, one of these ion modes remains unstable even at short perturbation wavelengths, where the driving wave would otherwise be stable. (Diss. Abstr. Int., B)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstracts 451, 924, 1095, and 1106.

1503 (CONF-720669–, pp 603-616) INELASTIC ATOMIC COLLISIONS AND THE STOPPING POWER OF HEAVY IONS. Bhalla, C. P. (Kansas State Univ., Manhattan). 1972. In Proceedings of Heavy-Ion Summer Study.

1504 (CONF-721018–16) GAMMA-RAY TRANSPORT AT 6 AND 8 MeV. Johnson, W. R.; Thompson, W. L.; Risher, D. H.; Hassler, L. A.; Rogers, J. E. (Virginia Univ., Charlottesville). 1972. 16p. Dep. NTIS (U. S. Sales Only).

From fourth international conference on reactor shielding; *Paris, France (9 Oct 1972).*

Experimental gamma-ray transmission and albedo measurements were made in beam-geometry for photon energies of about 6 and 8 MeV. Results for low- and medium-atomic number shields are in agreement with analytical predictions. However, for the combination of high-energy photon and high-Z shield, experimental values of transmitted dose and albedo are higher than would be calculated using standard techniques. A Monte Carlo program was developed which simulates the coupled transport of gamma rays and electrons. The results of the code indicate a significant contribution to transmitted dose and albedo from bremsstrahlung for the combination of high-energy source gamma rays and high-atomic number shields. (auth)

1505 (SLA-73-129) EFFECT OF LATERAL RELIEF ON BLOWOFF IMPULSE. Burchett, O. L. (Sandia Labs., Albuquerque, N. Mex.). Feb 1973. 19p. Dep. NTIS $3.00.

The MBBAY impulse calculation is modified to correct for the effects of lateral relief. Target geometry, material anisotropy, and the shape of the impulse producing, energy depth-dose profile determine the effect of lateral relief on the blowoff impulse. When the experimentally measured impulse generated by an "unknown" material is not corrected for lateral relief effects, the reference energy of the material that is determined from the experimentally measured impulse and the BBAY or the MBBAY impulse model will be overestimated. (auth)

1506 STOPPING POWER OF ORGANIC LIQUIDS FOR α PARTICLES OVER THE ENERGY RANGE 1 TO 8 MeV. Palmer, R.J.B. (City Univ., London). *J. Phys., B (London); 6: No. 2,* 384-392(Feb 1973).

Range-energy relations have been determined experimentally for carbon tetrachloride and for several hydrocarbon liquids. Differential molecular stopping powers have hence been obtained at various energies and these are compared with values for the comparable vapor phase. The molecular stopping powers of liquid hydrocarbons are found to be lower than those of the corresponding vapors, especially at low energies, and these differences are discussed. (auth)

1507 *ELECTRON DEPTH–DOSE DISTRIBUTION MEASUREMENTS IN TWO-LAYER SLAB ABSORBERS.* Eisen, H.; Rosenstein, M.; Silverman, J. (Univ. of Maryland, College Park). *Radiat. Res.; 52: No. 3, 429-447(Dec 1972).*

Electron depth–dose distribution measurements were made using the Chalkley–McLaughlin dye film dosimeter in two-layer slab absorbers of polystyrene/copper, polystyrene/tin, and aluminum/gold. A plane-parallel 2.0-MeV electron beam was used. Data were obtained for 12 cases by varying the location of the interface and by reversing the order of the slab components. Reproducibility of the measurements was ±6% (2 σ). An investigation of stopping-power ratio evaluation methods based on the treatment of the film dosimeter as a nonperturbing cavity demonstrated that a constant value could be used for each material in a two-layer absorber independent of the thickness of each layer. The error in absorbed dose determination introduced by the use of a constant value ranged up to 8%. A film placed at the interface between the two components of the slab was used to estimate the dose at the interface surfaces. Corresponding theoretical calculations were made using a multilayer electron transport computer code developed by Berger. Agreement between the measured and the calculated doses was within 10% for metal layers and within 15% for polystyrene. The discrepancies for polystyrene can be attributed to the omission of energy loss straggling in the calculation. (auth)

1508 INTERACTION OF NEUTRONS AND SECONDARY CHARGED PARTICLES WITH TISSUE: SECONDARY PARTICLE SPECTRA. Caswell, R. D.; Coyne, J. J. (National Bureau of Standards, Washington, DC). Radiat. Res.; 52: No. 3, 448-470 (Dec 1972).

Theoretical calculations were made of the secondary particle spectra for p, d, α, ^{9}Be, ^{11}B, ^{12,13,14}C, ^{14,15}N, and ^{16}O produced by interactions of 1- and 14-MeV neutrons with a four-element tissue containing the elements H, C, N, O. Detailed neutron cross-section data has been used in the calculation. Both "initial" spectra of the secondary particles as produced by nuclear reactions and the "equilibrium" spectra produced by particles slowing down are determined. This work is the first step in development of a quantitative description of the "physical" stage in the action of neutron radiation on biological materials. The spectra are input information for energy deposition studies for neutron microdosimetry and for models of the biological action of neutron radiation. (auth)

1509 RECONSTRUCTION OF DENSITIES FROM THEIR PROJECTIONS, WITH APPLICATIONS IN RADIOLOGICAL PHYSICS. Cormack, A. M. (Tufts Univ., Medford, MA). Phys. Med. Biol.; 18: No. 2, 195-207(Mar 1973).

The precise determination of body attenuation for x-rays or its stopping power for heavy charged particles, positron annihilation scanning, and, to a lesser extent, single γ-ray scanning all contain the same mathematical problem, namely, to determine a density distribution in space from its known projections on to one or more planes. Present methods of solving this problem involve taking slices through the distribution and considering the projected densities to be line integrals along lines through the slices and then using Fourier transforms, or orthogonal expansions of the line integrals, or a matrix inversion to determine the density distribution. An alternative method, due to Radon, enables the density to be inferred by integration. In addition, a generalization of the method to surface integrals is given and possible applications are suggested including an application to positron annihilation scanning. (auth)

1510 COMPUTED SPECTRA FROM DIAGNOSTIC AND THERAPEUTIC X RAY TUBES. Sundararaman, V.; Prasad, M. A.; Vora, R. B. (Dept. of Atomic Energy, Bombay). Phys. Med. Biol.; 18: No. 2, 208-218(Mar 1973).

Both the continuous spectra and the intensities of K-characteristic lines for diagnostic and therapeutic x-ray machines (45 to 250 kV) were computed using the Monte Carlo method. The results obtained have been compared with the theoretical results of Kramers and the experimental results of other workers. At low energies (<100 kV) the spectra obtained by Kramers, by the present method and by experiments are in good agreement. Spectra obtained in the present work show deviations of the order of about 10% from the experimental spectra at high energies. The difference between the spectra obtained by Kramers' method and the present work also increases with increase in energy. Further, change in the target angle does not appear to alter the shape of the spectrum significantly although the intensity varies by about 30% for a variation of angle of incidence from 30 to 75°. K intensities obtained in the present calculations are, in general, lower than the experimental values, but there is a wide variation in the experimental results themselves. (auth)

1511 CHARACTERISTICS OF A GAMMA RADIATION FIELD IN AN APPROXIMATION OF DOUBLE SCATTERING. Tarasov, G. P. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 11, 94-96(1972). (In Russian).

An accurate calculation was made of the T_2 component of the Green function which described the contributions of double scattering of radiation. On this basis a modified double local estimate was made, suitable for an unbiased evaluation of the differential characteristics of the radiation field. (KSW)

1512 PARAMETERIZATION OF 4 MV DEPTH-DOSE DATA FOR THE CLINAC-4 ACCELERATOR. Dixon, R. L. (Wake Forest Univ., Winston-Salem, NC). Radiology; 107: No. 1, 207-211(Apr 1973).

By separating the area and depth dependence of tissue air ratios for 4 MV x rays from the Varian Clinac-4 accelerator, parameters are obtained that can be used to generate all the quantities required for central axis dose calculations—both for isocentric and fixed TSD techniques. This method requires only two constants for each depth and provides the maximum generality with a minimum of data storage. The TAR, TMR, and percent depth dose tables can be generated with an accuracy better than ±1.5% for all field sizes and depths of clinical importance. The area dependence is found to be essentially the same for brass and lead flatness filters. (auth)

1513 COMPARISON OF X-RAY BEAMS USING THERMOLUMINESCENT DOSEMETERS. Spurny, Z.; Milu, C.; Racoveanu, N. (Radiologicka Dozimetrie Ustavu Jaderneho Vyzkumu, Prague). Phys. Med. Biol.; 18: No. 2, 276-278(Mar 1973).

The ratio of peak heights for a CaF_2, LiF tandem dosemeter was plotted as a function of energy from measurements with x-ray beams of six energies from 27 to 110 keV. It is shown that the tandem ratio is a better measure of the x-ray spectral shape than its effective energy, and hence the technique is recommended for the comparison of x-ray beams which have different filtration. It is suggested that a broader energy range could be covered by replacing LiF with BeO, and CaF_2 by SrS or $CaWO_4$. (UK)

1514 *DEPTH SELECTION BY MEANS OF SCATTERED* ELECTRONS: A METHOD TO DETERMINE ELECTRON LINE PROFILES. Baeverstam, U.; Bohm, C.; Ringstroem, B.; Ekdahl, T. (Univ. of Stockholm). Nucl. Instrum. Methods; 108: No. 3, 439-443(1973).

A method to determine the shape of line profiles from electrons scattered in thin films or foils is described. The method makes use of one measured line profile from electrons scattered in a foil of known thickness. Experiments show good agreement between calculated and measured line profiles. Several applications of the numerically calculated electron line profiles are discussed, the possibility to use them in foil thickness determinations is shown by experiment. (auth)

Shielding Calculations and Experiments

Refer also to abstracts 1600, 1610, 1611, and 1654.

1515 (CEA-CONF-2215) LINE OF SIGHT ATTENUATION OF PARTICLES TREATED BY A MONTE CARLO METHOD: THREE-DIMENSIONAL MERCURE-4 PROGRAM. Devillers, C.; Dupont, C. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). 1971. 14p. (In French). (CONF-721018-12). Dep. NTIS (U. S. Sales Only $3.00.

From fourth international conference on reactor shielding; Paris, France (9 Oct 1972).

The program MERCURE-4 integrates neutron or gamma ray line of sight point attenuation kernels (biological doses, gamma-heating, etc...) using a Monte-Carlo technique in a three-dimensional geometrical configuration and in the multigroup approximation. The program calculates and fits importance values which it uses for sampling the source particles, thus reducing the complexity of the problem for the nonspecialist in the use of the Monte-Carlo program. (France)

1516 (ORNL-TM-4060) SHIELDING AGAINST THE NEUTRONS PRODUCED WHEN 400-MeV ELECTRONS ARE INCIDENT ON A THICK COPPER TARGET. Alsmiller, R. G. Jr.; Barish, J. (Oak Ridge National Lab., Tenn.). Apr 1973. Contract W-7405-eng-26. 18p. Dep. NTIS $3.00.

Neutron-transport calculations were carried out using the method of discrete ordinates, and the dose equivalent as a function of radius in spherical shields of various compositions is presented. The incident-neutron spectra used are characteristic of the spectra emitted in the angular intervals of 0 to 30°, 30 to 60°, 60 to 120°, and 120 to 180° when 400-MeV electrons are incident on a thick copper target. Results are given for shields of soil, concrete, ilmenite, iron, and iron followed by soil. (auth)

1517 GAMMA-RAY SHIELDING BY CONCRETES WITH *DENSITIES ABOVE 4 g/cm³*. Sprenger, H.; Krueger, F. W. (VEB Kombinat Kraftwerksanlagenbau, Berlin). Kernenergie; 15: No. 7, 232-234(Jul 1972). (In German).

Concretes with high densities above 4 g/cm³ are produced above all using iron ores and iron scrap. The effects of different chemical composition of these concretes on shielding properties were studied for quantum energies in the range from 0.3 up to 10 MeV. From this it was shown that special chemical composition may be left out of account in most of all shielding problems also for these concretes and calculations can be made using a mean attenuation function. The parameters for the attenuation function are given. (auth)

PHYSICS (THEORETICAL)

General

Refer also to abstract 1193.

1518 *(JINR-P10-6702)* SPECTRAL TRANSFORMATIONS BY DIGITAL COMPUTERS. Soroko, L. M.; Strizh, T. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 137p. (In Russian). Dep. NTIS (U. S. Sales Only) $9.00.

New methods of spectral data processing on computers are reviewed. The description of fast algorithms as well as typical programs is given. The methods presented in the survey essentially reduce the time of computation which allows one both to process megachannel information and to perform spectral analysis of large data arrays in real time. The paper reviews the periodicals; the bibliography contains 170 references. (auth)

1519 NEW DEVELOPMENTS IN HARTREE-BOGOLYUBOV THEORY AND SOME GENERALIZATIONS TO EXACT CORRELATIONS IN QUANTUM MECHANICS. Herbut, F.; Vujicic, M. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). pp 185-233 of Proceedings of the XV International Summer Meeting of Nuclear Physicists on Nuclear Structure. Kukoc, A. H. (ed.). Belgrade; Boris Kidric Inst. of Nuclear Science (1972).

From 15th international summer meeting of nuclear physicists on nuclear structure; Hercegnovi, Yugoslavia (17 Aug 1970). See CONF-700865-.

The discussion covers many-fermion and quasiparticle space, one-particle space, methods of solution, and exact two-subsystem correlations. (JFP)

1520 PROGRESS IN WEYL'S PROBLEM ACHIEVED BY COMPUTATIONAL METHODS. Baltes, H. P. (Freie Univ., Berlin); Hilf, E. R. Comput. Phys. Commun.; 4: No. 2, 208-213 (Nov 1972).

The smoothed eigenvalue distribution for the scalar, and the electromagnetic vector, wave equations were studied for large, but finite wavenumbers k by counting the first 10^6 eigenvalues for various shapes of the domain. The results have implications on the Fermi-gas model of nuclear matter, the electron gas as well as the long-wave acoustic vibration modes in small crystals, the laws of black-body radiation, the acoustics of complicated resonators, and the thermodynamics of perfect gases in a finite volume. The relevance of the computational procedure is compared to that of the analytical methods yielding asymptotic expansions for the eigenvalue distribution which are valid in the limit of infinite k. As an illustrative example for the computational procedure, the calculation of the electromagnetic mode density in a lossless cavity resonator with the shape of a circular cylinder is presented. This calculation comprehends the computation of the first 10^4 zeros of the Bessel functions. (auth)

1521 PRACTICAL QUANTUM MECHANICS. II. Fluegge, S. Die Grundlehren der Mathematischen Wissenschaften, Band 178. New York; Springer-Verlag, New York, Inc. (1971). 300p. $19.10.

Volume II covers the following topics: particles with spin; many-body problems; nonstationary problems; the relativistic Dirac equation; and radiation theory. A mathematical appendix is included. (LBS)

1522 PRACTICAL QUANTUM MECHANICS. I. Fluegge, S. Die Grundlehren der Mathematischen Wissenschaften, Band 177. New York; Springer-Verlag, New York, Inc. (1971). 366p. $22.20.

Volume I treats the following topics: general concepts; one-body problems without spin; problems of two or three degrees of freedom without spherical symmetry; the angular momentum; potentials of spherical symmetry-bound states and elastic scattering; the WKB approximation; and the magnetic field. (LBS)

1523 FOUNDATIONS OF QUANTUM THEORY. Wieder, S. New York; Academic Press, Inc. (1973). 411p. $13.95.

Part I covers nonrelativistic one-particle systems. After some introductory material on historical respects and classical mechanics, the text sets the mathematical foundation of the quantum theory using commutator algebra and Dirac's bev and keV notation and proceeds to show the connection with Schroedinger's wave mechanics. Special attention is paid to spin and orbital angular momentum in central force systems. Methods of approximation are developed and applied to problems in modern physics. Common approaches used in the theory of scattering are discussed. Part II treats many-particle systems. Indistinguishability and symmetry are related to exchange and exclusion effects. Both real and ideal Fermi and Bose systems are discussed and applied to many-electron atoms, molecules, and solids. In the third and final part, relativistic particles are considered with emphasis on the electron and the Dirac equation. Field quantization is the subject of the final chapter in which a development of quantization of the electromagnetic field and the photon-electron interaction is presented. (LBS)

Quantum Field Theories

Refer also to abstract 1160.

1524 (NP-19721) FOUNDATIONS OF SPECIAL RELATIVITY: KINEMATIC AXIOMS FOR MINKOWSKI SPACE-TIME. Schutz, J. W. (Monash Univ., Clayton (Australia)). Aug 1971. 329p. Dep. NTIS (U. S. Sales Only) $18.50.

Thesis.

Minkowski space-time is developed in terms of undefined elements called "particles" and a single undefined relation, the "signal relation." Particles correspond physically to "inertial particles" and the signal relation corresponds to "light signals." The undefined basis is similar to that of Walker [1948]. (JFP)

1525 EXACT KINETIC EQUATION FOR CLASSICAL SYSTEMS. Demendy, Z. (Univ. of Heavy Industry, Miskolc, Hungary). Physica; 64: No. 1, 82-92(15 Feb 1973).

Starting from the asymptotic evolution equation of the vacuum part of the distribution vector which has been derived previously, a general, closed equation for the one-particle distribution is derived. The resulting equation is valid only in asymptotic time and thermodynamic limits and it is applicable only for pair-interacting systems. The general equation is studied in a generalized Vlasov approximation for inhomogeneous systems, and a new kinetic equation is derived. (auth)

1526 SYMMETRY OF THE DYNAMICAL EQUATIONS OF QUANTUM FIELD THEORY. Likhtman, E. P. (Lebedev Inst. of Physics, Moscow). Teor. Mat. Fiz.; 15: No. 1, 142-145(Apr 1973). (In Russian).

Two formulations of the requirement of invariance of quantum field theory under the group G, the generators which include the Hamiltonian, are considered. According to the first formulation, all generators of the group, expressed in terms of quantized fields, must satisfy the commutation relations generating the algebra of generators of the group G. It is shown that this requirement does not imply any restrictions on the interaction Hamiltonian and the S-matrix. If we want to consider only the Hamiltonians corresponding to theories with the invariant S-matrix, then it is sufficient to use the second formulation of the requirement of invariance. The second formulation can be obtained from the first one by means of imposing the following additional condition: all generators can be expressed by means of three-dimensional integrals over the space from local functions of the fields. (auth)

1527 INVARIANT BOX METHOD IN QUANTUM THEORY OF SPINOR FIELD. Chernikov, N. A.; Shavokhina, N. S. (Joint Inst. for Nuclear Research, Dubna, USSR). Teor. Mat. Fiz.; 15: No. 1, 91-99(Apr 1973). (In Russian).

By the example of the de Sitter spherical space-time the general properties of quantum theory of the spinor field are realized, which leads to the invariant box method. (auth)

1528 O-INVARIANT U-CYCLIC WEYL SYSTEMS. Damaskinskii, E. V. (Leningrad Inst. of Aviation Instrument Building). Teor. Mat. Fiz.; 15: No. 1, 70-77(Apr 1973). (In Russian).

We discuss U-cyclic Weyl systems invariant under the group of all unitary operators on the test-function space. It is shown that the class of vacuum Weyl systems is exhausted by the Weyl systems generated by Gaussian measures. (auth)

1529 LOW-ENERGY THEOREMS AND DISPERSION RELATIONS IN QUANTUM ELECTRODYNAMICS. Solov'ev, L. D. Teor. Mat. Fiz.; 15: No. 1, 59-69(Apr 1973). (In Russian).

The Bogolubov axiomatic approach in quantum field theory is extended to electromagnetic interactions. The aim of the extension is to obtain dispersion relations and low-energy theorems to all orders in the electromagnetic interaction. (auth)

1530 CONVEXITY PROPERTIES OF THE LEGENDRE TRANSFORMATIONS (VARIATIONAL METHODS IN QUANTUM FIELD THEORY). Vasil'ev, A. N.; Kazanskii, A. K. (Leningrad State Univ.). Teor. Mat. Fiz.; 15: No. 1, 43-58(Apr 1973). (In Russian).

It is shown that the Legendre transformations in the scalar field theory are convex functionals in terms of variables which are to be interpreted as the disconnected Green functions. Hence *it follows, in particular, that the stationary point of these functionals* is an extremum. (auth)

1531 *FOURIER–LAPLACE TRANSFORMATION OF THE* GENERALIZED FUNCTIONS. Solov'ev, M. A. (Inst. of Theoretical and Experimental Physics, Moscow). Teor. Mat. Fiz.; 15: No. 1, 3-19(Apr 1973). *(In Russian).*

With the view of applications to the unrenormalizable and non-*localizable field theories, the Fourier–Laplace transformation* of the functionals on the test-function spaces of the S type is considered. (auth)

1532 STATISTICAL MECHANICS RESULTS IN THE $P(\phi)_2$ QUANTUM FIELD THEORY. Guerra, F.; Rosen, L.; Simon, B. (Princeton Univ., NJ). Phys. Lett.; 44B: No. 1, 102-104(2 Apr 1973).

Ideas and methods from classical statistical mechanics are applied to study the $P(\phi)_2$ self-coupled two-dimensional boson field theory in the Euclidean region. In particular, correlation inequalities of Griffiths type; the thermodynamic limit for the pressure, the average interaction and the entropy; and the equilibrium equations for states associated with a given interaction are considered. (auth)

1533 BERNSTEIN–SALZ CONJECTURE IN THE NONLINEAR LEE MODEL. Uliu, F. S. (Univ., Craiova, Romania). Acta Phys. Pol.; B4: No. 2, 287-289(1973).

A conjecture of Bernstein and Salz is investigated in the framework of the nonlinear Lee model; an argument is put forward that this conjecture is true. (auth)

1534 *CALLAN–SYMANZIK COEFFICIENT β IN A MASSIVE* THIRRING MODEL IN $2 + \epsilon$ DIMENSIONS. Geicke, J.; Meyer, S. (Freie Univ., Berlin). Phys. Lett.; 44B: No. 1, 85-87(2 Apr 1973).

Using perturbation theory it is found that there is no zero of the Callan–Symanzik coefficient $\beta(g,\epsilon)$ in a massive Thirring model *in $2 + \epsilon$ dimensions at a coupling $g \sim \epsilon^{\alpha}$ with positive α. This* follows from the identically vanishing of $\beta(g,0)$ in 2 dimensions. (auth)

Gravitation and General Relativity

1535 SCALAR–TENSOR THEORY AND SCALAR CHARGE. Bronnikov, K. A. (USSR Ministerial Council, Moscow). Acta Phys. Pol.; B4: No. 2, 251-266(1973).

For a general class of scalar-tensor theories of gravitation the properties of exact static spherically symmetric vacuum and electrovac solution are discussed. On the other hand, post-Newtonian perfect fluid metric for this class of theories is found and compared with the exact vacuum solution. This comparison shows that the post-Newtonian approximation employs a special value of the scalar charge-mass ratio. This limitation is removed if a term involving scalar charge density is introduced explicitly into the initial Lagrangian. Observational consequences are discussed. (auth)

REACTOR TECHNOLOGY AND REGULATION

Refer also to abstract 1959.

1536 (CONF-720459–) REACTOR CONFERENCE, HAMBURG, APRIL 11–14, 1972. (Deutsches Atomforum E. V., Bonn (West Germany)). 1972. 763p.

From Reactor conference; Hamburg, Federal Republic of Germany (F.R. Germany) (11 Apr 1972).

One-hundred-ninety-one papers on the present status of reactor theory and technology were presented at the conference and are included. The conference emphasized the use of practical operating experience in the design and construction of nuclear reactors as well as questions of reactor safety. Information is included on: reactor experiments; fuel elements, fuel cycle, and isotope techniques; design, construction, and operation of nuclear power plants and their components; and reactor concepts and their scientific problems. (LCL)

1537 (EURFNR–1063) ANNUAL SCIENTIFIC REPORT, 1971. Billiau, R.; Bobin, K.; De Coster, M.; Fredrix, H.; Hespeels, L. (eds.) (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). 317p. (BLG–467). Dep. NTIS (U. S. Sales Only).

Progress in the research programs at the CEN in Mol, Belgium is described. The programs include fast reactor development, thermal reactor development, basic research in physics and radiobiology, safety studies, radioisotope development and application, actinian research, the BR 2 materials testing facility operations, and associated scientific and technical support studies. (JWR)

1538 REACTOR TECHNOLOGY. Volume 15, Number 4. A Bimonthly Technical Progress Review Published for the Technical Information Center, USAEC. Washington, DC; Atomic Energy Commission (1972). 101p. $0.75.

Separate abstracts have been prepared for the three critical reviews in this issue of Reactor Technology which will be the last issue. (FS)

For abstracts of individual papers see: 1621–1623.

1539 OUTLOOK FOR NUCLEAR ENERGY. Pecqueur, M. (CEA, Paris). Ind. Miner.; 54: No. 11, 509-514(Nov 1972). (In French).

The reasons behind the development of nuclear energy are reviewed. The special characteristics of nuclear energy and the nuclear industry, the relation between nuclear energy and the environment, the various types of reactors (graphite moderated gas cooled reactors, light water cooled reactors, fast reactors), the characteristics of the fuel cycle, and the development policy of the nuclear industry are given. (FR)

1540 NUCLEAR POWER REACTORS: AN INTRODUCTION. Aust. Weld. Res.; 3: No. 1, 16-18(Mar 1972).

Brief explanations of the basic principles of and features of the BWR, PWR, PHW (CANDU and ATUCHA) and SGHWR power reactors are given. (AT)

1541 NUCLEAR POWER PLANT: A BRIEF SURVEY. Hayes, J. E. (State Electricity Commission of Victoria, Australia). Aust. Weld. Res.; 3: No. 1, 19-26(Mar 1972).

Descriptions are given of pressure vessel light water reactors (PWR and BWR), pressure tube reactors (CANDU, SGHWR, CANDU-BLW), high temperature gas cooled reactors, and fast breeder reactors. (AT)

Power Reactors, Non-Breeding, BWR-Type

Refer also to abstracts 1557, 1561, 1662, 1665, 1703, 1750, 1751, 1753, 1759, 1787, 1788, 1793, 1796, 1800, 1803–1807, 1810, 1811, 1814, 1815, 1819–1821, 1824–1827, 1834, 1835, 1837–1839, 1848, 1850–1852, 1860–1862, 1877–1879, 1883, 1884, 1901, 1902, 1904–1908, 1921, 1925, 1926, 1932, 1933, and 1936.

1542 (JAERI-M–4800) EXPERIMENTS ON NDI-TECHNIQUE BY ACOUSTIC EMISSION. Fujimura, T.; Kamata, H.; Nakanii, T.; Sugai, M. (Japan Atomic Energy Research Inst., Tokyo). Apr 1972. 30p. (In Japanese).

The results of experiments on the (non-destructive) acoustic emission method for in-service inspection of reactor pressure vessels are described. The method is useful and effective for the in-service inspection of the JPDR Reactor. In the JAERI, experiments have been made on the acoustic emission method since 1970. Acoustic emission is produced in the specimens by means of a tensile machine. In the acoustic emission apparatus made in JAERI, two systems are used for the simultaneous measurement of acoustic emission. The feasibility of the acoustic emission method for the in-service inspection of reactor pressure vessels was confirmed. (auth)

1543 (NEDM-10735) DENSIFICATION CONSIDERATIONS IN BOILING WATER REACTOR FUEL DESIGN AND PERFORMANCE. Ditmore, D. C.; Elkins, R. B. (General Electric Co., San Jose, Calif. Nuclear Fuels Dept.). Dec 1972. 48p. Dep. NTIS $4.50.

The fuel densification mechanism and the potential effects of this mechanism on the performance of GE BWR Zircaloy clad UO_2 pellet fuel are analyzed. 14 references. (auth)

1544 (REG/G-1-18(12-72)) STRUCTURAL ACCEPTANCE TEST FOR CONCRETE PRIMARY REACTOR CONTAINMENTS. (Directorate of Regulatory Standards (AEC), Washington, D. C.). 28 Dec 1972. 5p. DRS, Washington, DC Free.

An acceptable basis for developing an appropriate structural acceptance test for concrete containment structures of water-cooled reactors is presented. (DCC)

1545 (REG/G-1-35(2-73)) INSERVICE SURVEILLANCE OF UNGROUTED TENDONS IN PRESTRESSED CONCRETE CONTAINMENT STRUCTURES. (Directorate of Regulatory Standards (AEC), Washington, D. C.). 5 Feb 1973. 2p. DRS, Washington, DC Free.

An acceptable basis for developing an appropriate surveillance program for ungrouted tendons in prestressed concrete containment structures of light-water-cooled reactors is presented. (auth)

1546 DEPOSITS ON FUEL ELEMENTS IN THE BK-50 REACTOR. Zabelin, A. I.; Pshenichnikov, B. V.; Svyatysheva, T. S. At. Energ. (USSR); 34: No. 2, 81-84(Feb 1973). (In Russian).

Spectrometric, chemical and radiochemical techniques are described for the investigation of the composition of deposits on fuel elements in the BK-50 reactor. The deposit composition of corrosion products and their activity ratios at the time of reactor shutdown are given. The basic activity (more than 90%) of the deposits after a ten-month exposure period is due to the isotope zinc-65. (auth)

1547 WATER REUSE IN INDUSTRY. Part 1. Power Generation. Aschoff, A. F. (Sargent and Lundy Engineers, Chicago). Mech. Eng.; 95: No. 4, 21-25(Apr 1973).

The greatest quantity of water is used for the condensation of exhaust steam. A two-unit 2200 MW nuclear plant may require 1.5 million gal/min for this purpose on a once-through or open cooling cycle. The long range goal must be to recycle or reuse the water. The use and reuse of water at nuclear power plants are discussed. Wet mechanical, dry natural, and counter-flow natural-draft cooling towers are described. (FS)

1548 THERMAL NEUTRON SPECTRUM IN WATER MODERATED REACTORS. Lomakin, S. S.; Panfilov, G. G. At. Energ. (USSR); 34: No. 2, 117-118(Feb 1973). (In Russian).

Parameters of the energy distribution of neutrons were measured with the help of activation indicators in several types of water moderated reactors. Spectral indices and Cd ratios were obtained for ^{55}Mn and ^{63}Cu used as indicators. Experimental data were thus derived for the reactors VVR, MR, and VVER. Neutron temperatures of 375 to 400°K were measured for these three reactors as well as for RFR and MELUSINE. (KSW)

1549 BOILING WATER REACTOR CONTAINMENT SYSTEMS AND CONSTRUCTION. Palmeri, A. (Ebasco Service Inc., New York). Ing. Nucl.; 13: No. 3, 17-28(1972).

To confine radioactive materials and keep them from being driven into the atmosphere, in case of a BWR accident, containment structures are used. The primary containment consists of a drywell, which encloses the reactor shell; a pressure suppression chamber, which stores a large volume of water; and a connecting vent system between the drywell and suppression chamber. The secondary containment is the building which contains the drywell and the suppression chamber. The secondary containment provides controlled release of airborne radioactive materials and controlled release of the building atmosphere during accident conditions. This building houses refueling and reactor servicing equipment and new and spent fuel storage areas. (FS)

1550 POSSIBILITY OF DISMANTLING A NUCLEAR POWER STATION. Suguri, S. (Japan Atomic Energy Research Inst., Tokai). At. Jap.; 16: No. 7, 6-10(Jul 1972).

The Japan Power Demonstration Reactor (JPDR) of the Japan Atomic Energy Research Institute has been modified to double its thermal output from 45 MW to 90 MW. A steam separator had to be installed because recirculation flow increases with the doubling of thermal output. This necessitated installation of a canal between the reactor pool and the fuel storage pool. Biological shield concrete was removed to construct the canal. The plant was shut down on September 1, 1969 for the modification. Used poison curtains, in-core instruments, sample hangers, and failed control blades were scheduled for disposal. These were cut to fit into transfer casks before transporting to the waste disposal plant. Iso-neutron curves were calculated from shielding calculations. These results show that the highest specific activity in the concrete of the biological shield of JPDR is 1 Ci/g, contributed by the operation of the 411 EFPD. For further efficient dismantling operations, some more research would be valuable, including research on the effective collecting method of fine metal powder produced by plasma-arc torches, on reducing the cost of the dismantling, and on protection from radiation exposure. (JA)

1551 USER'S PROBLEMS AND MANAGEMENT OF FUEL ASSEMBLIES FOR LIGHT WATER REACTORS. Genshi Doryoku Kenkyukai Teirei Kenkyukai Nenkai Hokokusho; No. 45, vp. (Aug 1971). (In Japanese).

As the result of increasing power density in cores, fuel elements of BWRs and PWRs are being used under more severe conditions than before. Conditions such as thermal flux, coolant outlet temperature, power peaking factor, linear heat rate, and burnup, are compared for Dresden No. 1, Browns Ferry No. 1, Yankee, and Diablo Canyon No. 1 plants. Recent improvement in fuel design and development problems for the future are discussed together with the methods of improving the reliability of fuel performance. The improvement of PWR fuel rods by pressurized helium is explained. Various problems of fuel management are discussed from the standpoint of the utility. These include fuel guarantee, purchase of reloading fuel, and the method of lowering fuel cost. For in-core fuel management, the problems are explained, and the necessity to calculate and predict precise core performance by utilities is discussed. Answers to a series of questionnaires sent to 11 Japanese utilities are summarized. (JA)

1552 DEFINITIONS OF NUCLEAR REACTOR COOLANT PRESSURE BOUNDARY AND REACTOR CONTAINMENT BOUNDARY. Tokyo; Japan Electric Association (1972). 7p. (In Japanese).

A chapter of "Guiding Principles for Electric Engineering" prepared by the Japanese Association of Electricity is discussed. Reactor coolant pressure boundary is defined and applied to light water moderated and cooled power reactors. The range of the pressure boundary corresponding to each operating condition is defined. The definition of the container boundary, which is also applied to light water reactors, is given. Eleven figures showing pipes and valves are used to explain the container boundary. Practical examples of applying the above definitions to power reactors are given. Four figures showing the pressure boundary and the container boundary of the 800 MW(e) PWR and BWR power plants are attached. (JA)

1553 CONSTRUCTION OF OYSTER CREEK NUCLEAR REACTOR. Kregg, D. H. Aust. Weld. Res.; 3: No. 1, 35-36(Mar 1972).

Examples of welding problems encountered during construction of the Oyster Creek reactor are given. (AT)

Power Reactors, Non-Breeding, PWR-Type

Refer also to abstracts 1544, 1545, 1547, 1548, 1551, 1552, 1662, 1664–1667, 1669–1671, 1703, 1744, 1752, 1770, 1794, 1796, 1798, 1808, 1809, 1813, 1817, 1818, 1822, 1823, 1829–1833, 1840, 1844–1847, 1849, 1853–1859, 1863–1876, 1880–1882, 1885–1899, 1903, 1909, 1910, 1913–1919, 1922–1924, 1927–1930, 1935, and 1937–1942.

1554 (FEI-280) METHOD FOR DETERMINING THE COEFFICIENT TAKING INTO ACCOUNT THE ENERGY RELEASE FIELD MICROSTRUCTURE IN CHANNEL-TYPE REACTORS. Volkov, Yu. V.; Lyubchenko, V. F. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko Energeticheskii Institut). 1971. 22p. (In Russian). INIS.

The theory of random functions was used in determining the power density pressure tube type reactors. Differential equations were written which satisfied the power behavior in a tube depending on the depth of control rod insertion. Values of the calculated coefficient were compared with experimental values. (tr-auth)

1555 (IAE-2189) SMALL DIMENSION SUBCRITICAL ASSEMBLY FOR MEASURING NEUTRON-PHYSICS PARAMETERS OF LATTICES OF A TYPE VVER (WATER MODERATED POWER REACTOR) REACTOR. Aborina, I. N.; Komissarov, L. V.; Lunin, G. L. (Institut Atomnoi Energii, Moscow (USSR)). 1972. 17p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The possibility of using subcritical assemblies of small dimensions in the measurement of neutron physics fuel characteristics in WW-type reactor lattices was investigated. The uranium-graphite reactor F-1 was employed as a neutron source, and the spatial distribution of thermal and "epicadmium" neutrons about the uranium-water lattice (135 cm × 23 cm diameter) was measured with In and Mn detectors. Certain integral characteristics of the neutron energy spectrum were measured in the central region of the assembly during its exposure to thermal and epicadmium neutrons. An equilibrium energy spectrum of neutrons was established in the central region of the assembly, characterizing an infinitely extended lattice. (tr-auth)

1556 (INIS-mf-91) CONSTRUCTION OF NUCLEAR POWER STATIONS WITH VVER-400 TYPE REACTORS IN CZECHOSLOVAKIA. Hrdlicka, J.; Holub, J.; Hanzlik, J. 12p. (In Czech). (CONF-701214-8). INIS.

From 5th conference on nuclear power; Piestany, Czechoslovakia (1 Dec 1970).

Jaslovske Bohunice in western Slovakia and Dukovany in southern Moravia were chosen as the construction sites of two nuclear power plants using Voronezh-type reactors (V-1, V-2). Justification of this choice is briefly outlined, and certain problems connected with the construction of these power stations are described. (INIS)

1557 (MRR-30) CURRENT PROBLEMS IN DESIGN AND EVALUATION OF CONTAINMENTS FOR LARGE WATER COOLED POWER REACTORS. Karwat, H. (Technische Hochschule, Munich (West Germany). Institut fuer Mess- und Regelungstechnik). Oct 1966. 24p. (In German). Dep. NTIS (U. S. Sales Only) $3.25.

First, the high-pressure containment of large water-cooled power reactors is considered. In the case of an incident, pressure waves may arise which cannot be assessed by stationary calculations. Therefore, a new computer program is under development which takes these dynamic disturbances into account. In addition, a continuous monitoring system must replace the present arrangement where leak tests are performed only once per year. With respect to low-pressure containment, a new computer program is also under development which considers the various aspects of emergency cooling systems. Containment vessels are then discussed from the standpoint of metal-water interactions, release of fission products, content of fission products in the gaseous phase, and the reduction of iodine release through filters. (HBG)

1558 (NEIC-RR-49) PRESSURIZED WATER REACTORS. Bibliography, 1970–1971. Kowalski, A.; Oleszczak, A. (comps.) (Nuclear Energy Information Center, Warsaw (Poland)). 1972. 96p. Dep. NTIS (U. S. Sales Only) $7.00.

A bibliography is presented of 951 items published during 1969, 1970, and 1971 are related to the design, development, operation, and performance of PWR reactors and associated components. A subject index and named reactor index are included. (LCL)

1559 (WAPD-MRP-138) PRESSURIZED WATER REACTOR (PWR) PROJECT. Technical Progress Report, January 26–July 25, 1972. (Bettis Atomic Power Lab., Pittsburgh, PA). 1972. Contract AT(11-1)-Gen-14. 22p. Dep. NTIS $4.00.

Plant operations and testing on three reactor coolant loops continued satisfactorily during this period. The total operating time with PWR Core 2 Seed 2 was increased to approximately 7400 equivalent full power hours (EFPH). The power capability of PWR Core 2 Seed 2 for swing load operation for the interval from 7000 to 9000 EFPH was reassessed and the new calculations demonstrated that the maximum permissible power for swing load operation could be increased to a value greater than that originally determined for the 7000 to 9000 EFPH interval. Measured coolant flows at all core locations remained in excess of design values of two, three, and four loop operation. The program for further improvement of liquid radioactive waste disposal systems continued. The second PWR reactor core changeout plans were developed. (auth)

1560 RECENT DEVELOPMENTS ON A PRESSURIZED FUEL AND ENGINEERED SAFETY FEATURES IN PRESSURIZED WATER REACTORS. Roh, E. J. Korean Nucl. Soc.; 4: No. 4, 345-352 (Dec 1972). (In Korean).

1561 JAHRBUCH DER DAMPFERZEUGUNGSTECHNIK. 2. Ausgabe 1972/73. (Annual Review of Steam Generator Technique. Second Edition, 1972/73). Essen; Vulkan Verlag Dr. W. Classen (1972). 448p.

The present status and the direction of future development are discussed for steam generators. Reviewed are basics of steam techniques, construction and operation of steam generators, firing and auxiliary equipment, vessel mechanics, control and automation, chemistry, technical rules and regulations, and research. Operational results of the three demonstration nuclear power plants Grundremmingen, Obrigheim, and Lingen are discussed with respect to fuel, heat exchanger, environmental effect, and disposal of radioactive waste. The steam generators in nuclear power plants with pressurized water reactors are reviewed as to design, construction, and operational behavior. Steam generators with natural circulation are well suited for pressurized water reactors because of their storage capacity which permits fast power changes. (HBG)

1562 PRE-LICENSED NUCLEAR PLANTS: $350 MILLION, F.O.B. FLORIDA. Olds, F. C. Power Eng.; 77: No. 4, 46-49 (Apr 1973).

An assembly line in Jacksonville, Florida will mass-produce complete nuclear power plants which are mounted on floating platforms, pre-licensed, and ready to be towed to utility off-shore sites for fueling and start-up. The plant is about 400 ft square, 40 ft from deck to keel and it will draw 30 ft of water. From the keel to the top of containment will be 209 ft. Two 1150 MW(e) pressurized water reactors will be supplied by Westinghouse. Plant safety standards are comparable to those of land-based plants. (FS)

1563 RADIOACTIVE WASTE GAS FILTERED BY CHARCOAL BED. Mod. Power Eng.; 67: No. 2, 40(Feb 1973).

Although radiation emission from the San Onofre nuclear generating station in Southern California was below U. S. and international standards, a waste-gas treatment system was installed. The system removes 99.9% of radioactive xenon and krypton gases diffusing from the fuel elements. The gases are passed through an oxygen recombiner where small amounts of oxygen and ozone are combined with hydrogen to form water. Gas temperature is reduced by a cooler and water vapor is removed by a molecular sieve before the gases enter a regenerative heat exchanger and a liquid-nitrogen bath for further cooling to −184°C. Finally the gases go through a charcoal bed, which traps the active gases. Warming the charcoal releases the gases to storage containers which are held at the station until most of the radioactivity has decayed. (CA)

1564 PRESSURE VESSEL FOR A NUCLEAR REACTOR. (to Electricite de France). French Patent 2,114,258. 30 Jun 1972. Filed date 20 Nov 1970. 9p. (In French).

A prestressed concrete pressure vessel for a pressurized water nuclear reactor (integrated exchange type) operating with an indirect cycle is described. The vessel possesses two cavities separated by a sealed partition: one of the cavities contains the reactor core and is cooled by the primary coolant; the other cavity contains a secondary coolant at a lower pressure than the primary coolant and also certain thermal exchange devices between the coolant fluids. These devices are connected to the first cavity forming a closed circuit for the primary coolant. An indirect cycle nuclear reactor having a pressurized water primary coolant and a boiling water secondary coolant is presented. (FR)

1565 OPTIMIZATION OF IN-CORE NUCLEAR FUEL MANAGEMENT IN A PRESSURIZED WATER REACTOR. Stout, R. B. Corvallis, OR; Oregon State Univ. (1973). 168p. University Microfilms Order No. 73-7119.

Thesis (Ph. D.).

Fuel loading patterns which have a minimum power peak are economically desirable to allow power reactors to operate at the highest possible power density and to minimize the possibility of fuel failure. A computer code called SHUFLE was developed for pressurized water reactors which shuffles the fuel in search of the lowest possible power peaking factor. An iterative approach is used in this search routine. A radial power distribution is calculated from which the program logic selects a movement of fuel elements in an attempt to lower the radial power peak. Another power calculation is made and the process repeated until a predetermined convergence is reached. The logic by which the code decides the fuel movement is presented, along with the criteria for accepting or rejecting the move after a power calculation of the new loading pattern is made. A 1.5 group course mesh diffusion theory method was used to obtain the power distribution for each SHUFLE iteration. Convergence to a final loading pattern varies from about 10 to 40 shuffling iterations depending on the initial loading presented to the code. Since the typical computer running time for a one-quarter core power distribution with this 1.5 group method is only one to a few seconds, depending on the loading, convergence to a good loading pattern takes on the order of one minute on a Univac 1108. The low computer cost plus ease of operation should make this code of considerable use in determining loading patterns with minimum power peaking for any given set of fuel elements. The program also has burnup capability which can be used to check power peaking throughout core life. A parametric analysis study of fuel cycle costs for a PWR is also presented. Cost parameters analyzed were variations in the cost of yellow cake, enrichment, money, fabrication, and reprocessing plus changes in burnup, load factors, power densities, and the effect of forced early discharge. Figures are presented to indicate total fuel costs as a function of burnup for these cost parameters. Linear relationships for minimum cost and optimum burnup are presented for each parameter. (Diss. Abstr. Int., B)

1566 INSPECTION IN NUCLEAR POWER PLANTS. Quaass, S. T. Aust. Weld. Res.; 3: No. 1, 37-44(Mar 1972).

Pre-operational, commissioning, and operational inspection are described and particular reference is made to examination of PWR plant systems. (AT)

Power Reactors, Non-Breeding, Graphite Moderated

Refer also to abstracts 1716, 1766, 1797, 1842, and 1843.

1567 (AEEW-R-821) METHOD FOR STUDYING FUEL MANAGEMENT IN ADVANCED GAS-COOLED REACTORS IN THREE SPACE DIMENSIONS. Buckler, A. N. (Atomic Energy Establishment, Winfrith (England)). Jan 1973. 29p. Dep. NTIS (U. S. Sales Only) $3.50.

A method for studying fuel and absorber management problems in commercial AGR'S is described in which three-dimensional neutron flux solutions are employed and in which absorber insertion is determined in order to satisfy imposed operating conditions. The method uses libraries of lattice data against irradiation which may be enrichment and temperature dependent and effectively simulates the three-dimensional burnup of the whole core as a function of time. The method has been embodied in the MOPSY code and represents an extension to three-dimensions of the previously reported codes of the ODYSSEUS series which use a combination of two-dimensional flux solution with axially averaged data. Results are presented which indicate that for integral properties, such as refuelling rates and channel powers as a function of time, the two-dimensional approach is satisfactory. The axial power profiles obtained from the MOPSY approach however can be significantly different from those employed in the simpler, separable approach, and lead to improved evaluation of fuel element temperatures. (auth)

1568 (DP-Report-544) RESULTS OF THE INJECTION OF IMPURITIES INTO THE DRAGON REACTOR PRIMARY COOLANT. Carlyle, M.; Kinsey, D. V. (Atomic Energy Establishment, Winfrith (England)). Jun 1969. 39p. Dep. NTIS (U. S. Sales Only) $4.00.

An experiment on the effects of water vapor and gaseous impurities in the primary coolant for the Dragon Reactor is described. (JWR)

1569 (DP-Report-627) DRAGON REACTOR FUEL HANDLING EQUIPMENT. Dragon Project. Kinkead, A. N.; Smith, P. C. (Atomic Energy Establishment, Winfrith (England)). May 1969. 35p. (CONF-681229-1). Dep. NTIS (U. S. Sales Only) $3.75.

From symposium on refueling of gas-cooled reactors; London, UK (12 Dec 1968).

The fuel handling equipment for the Dragon Reactor Experiment has presented some unusual engineering problems because its design was completed in advance of that for any similar equipment on other reactors using helium as coolant. The adoption of an in-built charge/discharge machine has facilitated access to the core for removal and replacement of numerous fuel element designs during off-load refueling periods. The general scheme for fuel changing is outlined and reasons are given for special measures specified initially with the aim of ensuring functional uniformity combined with maximum reliability. The charge/discharge machine is described in some detail as one of the unique features in the fuel cycle system. Component development testing is mentioned and a report is given of operational experience with the equipment over a period of 4 years. (auth)

1570 (FEI-291) NEUTRON SPECTRA OF THE "SCANDIUM" AND "IRON" BEAMS OF THE OBNINSK REACTOR. Kuzin, E. N.; Belov, S. P.; Dvukhsherstnov, V. G.; Kozlov, E. D.; Shchadin, N. N.; Gorshkov, A. P.; Chaikovskii, V. G. (Gosudarstvennyi Komitet Po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko Energeticheskii Institut). 1971. 13p. (In Russian). INIS.

Neutron spectra of "scandium" and "iron" beams from a uranium-graphite reactor (Obninsk Power Station) were determined using hydrogen and methane proportional counters for recoil protons. This technique was extremely useful for obtaining physical and nuclear constants at energies of 2 and 24.5 keV. (tr-auth)

1571 (FEI-334) CONCERNING SOME CHARACTERISTICS OF THE RELIABILITY OF THE EVAPORATIVE CANALS OF TYPE BAES NUCLEAR REACTORS. Volkov, Yu.V.; Kostromin, A. G.; Lyubchenko, V. F. (Gosudarstvennyi Komitet po Ispol'-Zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko Energeticheskii Institut). 1972. 15p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The probable power levels of the evaporation canals of BAES-type reactors can be determined by a solution of the Kolmogorov equation for a one-dimensional Markov process. Formulas were obtained for the calculation of some probable characteristics of emission in the critical region. An analysis was made of the evaporation canals of the second BAES block. (tr-auth)

1572 (GULF-GA-A-12422) HTGR BASE PROGRAM. Quarterly Progress Report for the Period Ending November 30, 1972. (Gulf General Atomic Co., San Diego, Calif). 25 Jan 1973. Contract AT(04-3)-167. 198p. Dep. NTIS.

The High-Temperature Gas-cooled Reactor (HTGR) work reported includes studies of basic fission-product distribution mechanisms, recycle fuel studies (including designing and testing of recycle test elements) and exploration of head-end reprocessing methods (as part of a national recycle plan and of a recycle fuel plant), and physics and fuel management studies. Materials studies include irradiation and analysis of fuel particles in capsules to evaluate fuel systems, and basic studies of control materials and of carbon and graphite. Experimental procedures and results are discussed and, where appropriate, the data are presented. (auth)

1573 (GULF-GA-A-12440) SPECTROGRAPHIC PROCEDURES USED IN ANALYSIS OF FUELS AND MATERIALS FOR FORT ST. VRAIN NUCLEAR POWER REACTOR. Chaney, C. L. (Gulf General Atomic Co., San Diego, Calif.). 15 Mar 1973. Contract AT(04-3)-633. 135p. Dep. NTIS $8.75.

The spectrographic analysis procedures described satisfy specifications for HTGR fuels and materials. Brief descriptions are presented for direct-analysis, preconcentration, and semi-quantitative emission spectrographic analysis techniques. Fuel standards preparation is also discussed. (auth)

1574 (JAERI-M-4883) FECUND CODE FOR CALCULATING UNSTEADY-STATE DIFFUSION OF FISSION PRODUCTS IN HIGH TEMPERATURE GAS-COOLED REACTOR. Makino, M.; Yasukawa, S. (Japan Atomic Research Inst., Tokyo). Jul 1972. 159p. (In Japanese).

A computer code FECUND was developed for calculating the unsteady diffusion of fission products in fuel elements of a high temperature gas-cooled reactor. In the code, the reactor core is treated as a single fuel channel and fission product releases are calculated from the layers of coated fuel particles to the outermost surface and from the layers of a fuel channel to a primary coolant loop. Fuel channels treated here are solid and hollow cylindrical, annular and spherical fuel channels. Elementary processes of fission product migration in coated fuel particles include β-decay, generation by fission yield, transmutation of precursors, concentration diffusion, and fission recoil. In the fuel channel included are β-decay, release of fission products from the coated fuel particles, concentration, and thermal diffusion. These are treated as one-dimensional and radial unsteady diffusion problems. Because of the nature of fission product chains, the parent-daughter pairs of nuclides are treated simultaneously in the code. In calculating the space distribution of fission products in a fuel channel, their movements not only in radial but also in axial directions, by both concentration and thermal diffusions, are taken into consideration. The FECUND code is written in FORTRAN-IV and the calculation time for a typical problem is about 30 sec with IBM-360. (auth)

1575 (JAERI-M-4905) VIBRATION OF REACTOR STRUCTURE, PART 2-7. PRELUDE-1: Seismic Response Analysis Code for Core Formed with Blocks. Ikushima, T. (Japan Atomic Energy Research Inst., Tokyo). Jul 1972. 37p. (In Japanese).

The computer code PRELUDE-1 was prepared for analyzing the seismic response of the HTGR core, which consists of graphite-block type fuel. Features of the code are as follows: the model treated is the discontinuous multi-mass points system; any seismic wave can be taken as the input; numerical analysis is performed by the so-called Runge-Kutta-Gills step-by-step integration; the time intervals for calculation, graphic representation of the results, and printout of the results can be chosen arbitrarily, so that computer time is saved depending on the purpose of the calculation, and the accuracy of the calculation can still be maintained; and subroutines for the graphic representations with a CALCOMP plotting machine are available in the code. The code is written in FORTRAN IV and can be used with either the IBM 360 or the FACOM 230-60. The calculation of the seismic response is about 0.9 second per time step, for thirteen mass-points. (auth)

1576 (RD/B/N-630) STUDY OF TURBULENT FLOW IN SIMPLE DUCTS. Bennet, E. J. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs). Mar 1966. 24p. Dep. NTIS (U. S. Sales Only) $3.25.

An interpretation of fluid velocity distributions in ducts of simple shape is presented in which the flow can be considered as made up of various zones. Near the duct walls are the conventional viscous, transition and turbulent wall regions; in the center of the duct a zone of constant eddy diffusivity is considered. These assumptions improve on the universal velocity profile and give a velocity distribution which is smooth and continuous across zones, and gives zero velocity gradient at the position of zero shear stress. This work could form a basis for understanding some of the unexplained discrepancies which appear when the heat transfer and pressure drop performance of an A.G.R. rod cluster, of a single rough rod and of a rough tube are compared. (auth)

1577 CONCEPT OF A COMPOUND PLANT WITH A HIGH TEMPERATURE REACTOR FOR STEEL PRODUCTION. Ermisch, K. (Fried. Krupp GmbH, Essen); Haehn, P. C.; Schafstall, H. G.; Seelig, H. F.; Keller, J.; Nitschke, E. Kerntechnik; 15: No. 1, 9-15(Jan 1973). (In German and English).

1578 DEVELOPMENT, CONSTRUCTION, AND OPERATION OF HIGH-TEMPERATURE GAS-COOLED REACTOR NUCLEAR POWER PLANTS. Johnston, T. A. (Gulf General Atomic, Inc., San Diego, CA); Fischer, P. U. VGB Kraftwerkstechnik; 52: No. 5, 390-396(1972). (In German).

The operational experiences of the HTGR prototype Peach Bottom reactor are presented in connection with gas-cooled high temperature reactors. The availability, fuel problems (cladding tube defects) and fission products of the first and second reactor core are discussed. Furthermore, a look is taken at the Fort St. Vrain reactor. The licensing procedure and the present state of construction are described taking the pressure vessel and emergency cooling into consideration. The prospects for further developments concerning the nuclear steam generation system, prestressed concrete containers, reactors and technology for bigger units (1,160 and 770 MW(e)) are given. Future applications of the HTGR for gas turbines with closed circuits and the effects on the environment especially advantageous to the HTGR are mentioned. (GF)

1579 HIGH-TEMPERATURE GAS-COOLED REACTORS FOR PROCESS HEAT. Quade, R. N. Power Eng.; 77: No. 4, 50-53 (Apr 1973).

The HTGR, which was developed as a heat source for electric generating plants, has a nominal core outlet temperature of 1400°F. This temperature can be increased to 1620°F making the reactor a potential heat source for high temperature processes such as coal gasification, steel making, and hydrogen production. In the reactor, He, the coolant, is pumped at high pressure through vertical coolant channels in the core. The core structure is formed of hexagonal graphite blocks. This graphite makes it possible to achieve high core outlet temperatures. (FS)

1580 GAS TURBINE HTGR AND THE ENVIRONMENT. Bell, F. R.; Koutz, S. L. (Gulf General Atomic Co., San Diego, CA). Combustion; 44: No. 10, 20-25(Apr 1973).

Development and construction of nuclear gas turbine power plants with dry air cooling are recommended as a means of continuing economical power generation while minimizing the environmental and water resource impact of power generation. Such plants not only produce power at high efficiencies, but also eliminate water consumption for power plant cooling, reject heat in the least objectionable manner, and make possible flexibility and economy in power plant siting. The feasibility of the dry cooled nuclear power plant is assured since the recommended system involves the combination of the high-temperature gas-cooled nuclear reactor (HTGR), which has already been developed, in a direct cycle with

a helium gas turbine, which is based on existing technology. The nuclear gas turbine has great potential for long-range development and improvement to performance levels considerably exceeding those of current nuclear power systems. (auth)

1581 GULF LOOKS AT HTGR's ROLE IN BREEDER ERA. Fortescue, P.; Stewart, H. B. Elec. Light Power (Boston); 51: No. 5, 35-37(Mar 1973).

Fast breeder reactors might best be used as fuel factories for high temperature gas-cooled reactors (HTGRs) driving closed cycle gas turbines. The argument focuses on the HTGR's high conversion ratio and a claimed capital cost advantage for the gas turbine system. (auth)

1582 RADIATION DAMAGE OF CARBON MATERIALS FOR HIGH TEMPERATURE GAS REACTORS. Genshi Doryoku Kenkyukai Teirei Kenkyukai Nenkai Hokokusho; No. 45, vp. (Aug 1971). (In Japanese).

Dimensional change in graphite induced by fast neutrons is a serious problem, when graphite is used as a construction material for high temperature nuclear reactors. Problems are: the duration of the contraction effect of a graphite moderator, capability of breaking by stress induced by radiation, and release of the induced stress in the graphite before breakage. The difference between a three dimensional graphite lattice and a turbostatic structure is illustrated. Pyrolytic carbon coated fuel particles must be resistant to fission fragments, irradiation by fast neutrons, internal pressure of fission product gas and the fuel kernel and must contain the fission products. Radiation research places emphasis on the pyrolytic carbon coating. The spearhead attack observed in the pyrolytic carbon coating of irradiated fuel in the Dragon high temperature reactor and results of experiments on spearhead attack are reviewed. Damage of the pyrolytic carbon coating caused by fast neutrons is reviewed. (JA)

1583 INSTRUMENTATION TECHNIQUES FOR STRAIN MEASUREMENTS IN CONCRETE PRESSURE VESSELS AND SIMILAR STRUCTURES. Hornby, I. W. (Central Electricity Research Labs., Leatherhead, Eng.). Strain; 8: No. 3, 110-111 (Jul 1972).

Instruments and techniques employed by the Central Electricity Generating Board for short and long term strain measurements in prestressed concrete pressure vessels are described, and the methods adopted for data logging and subsequent data reduction are given. The measurements and tests on samples required to interpret the site readings are also described. (auth)

1584 GAS-COOLED NUCLEAR REACTORS. Cook, R. K. (to British Nuclear Design and Construction Ltd.). British Patent 1,300,054. 20 Dec 1972. Filed date 18 Dec 1968. 4p.

Reference is made to nuclear power installations comprising a gas cooled reactor used as a source of thermal power to drive a direct cycle gas turbine power unit. The object of the arrangement described is to make provision for the protection of the reactor containment vessel from the effects of the high temperature coolant gas, so that higher gas cycle temperatures can be employed. Those parts of the containment vessel subject to the high temperature are provided with a thermally insulating lining that has a cooling jacket through which, during operation of the reactor, at least some of the coolant gas recirculated to the reactor flows, so as to limit the temperature of the lining. A portion of the recirculated coolant gas may be bled off from the coolant circuit at a point upstream of the reactor core to pass through the cooling jacket and then rejoin the coolant circuit at a second point upstream of the reactor core but downstream of the first point. Alternatively the cooling jacket may form part of the coolant circuit upstream of the core, so that substantially the whole of the coolant passes through the jacket. (UK)

1585 NUCLEAR POWER PLANT. Love, J. B. (to United Kingdom Atomic Energy Authority). British Patent 1,297,939. 29 Nov 1972. Filed date 26 Feb 1969. 3p.

Reference is made to nuclear power plants of the type wherein a gaseous primary coolant, such as CO_2, is used to generate steam from a liquid secondary coolant, and arrangements made to cope with varying load demands. The system described is based on the concept that by increasing the temperature of the feed water at part load some of the plant items, including the reactor core, can be used as a heat store so that sudden increases in load demand can be met. The plant has means for transferring heat from a fraction of the generated steam to the secondary liquid feed, the transferred heat being inversely variable with turbine load. The transfer means comprises a heat exchanger located between the liquid feed pump and a steam generating heat exchanger, with a flow control valve responsive to a turbine load signal for controlling the steam supply to the heat exchanger. When a demand for increased power is received, during the transitional period of increasing reactor power the demand for more steam is met by reducing the supply to the feed heat exchanger. (UK)

1586 FUEL ELEMENTS. Bujas, R. (to Commissariat a l'Energie Atomique). French Patent 2,122,367. 1 Sep 1972. Filed date 22 Jan 1971. 5p. (In French).

A fuel element for a high temperature reactor having a structure enabling the support to be effected directly by the graphite block in which the fuel channel is provided is presented. Cylindrical elements with external radial fins for centering the element with respect to the internal surface of the vertical axis cylindrical channel receiving them are employed. At least one of the fins (designated: supporting fin) possesses along part of its length a radius superior to that of the other fins. This part of the supporting fin rests at its lower end on a special part arranged in the groove of the channel wall in which the fin is located. (FR)

1587 FUEL ELEMENT FOR NUCLEAR REACTOR. Bujas, R.; Ringot, C. (to Commissariat a l'Energie Atomique). French Patent 2,121,398. 25 Aug 1972. Filed date 8 Jan 1971. 5p. (In French).

A fuel element (principally intended for a high temperature reactor) is presented. This element has a fuel part with a general annular form externally or internally clad with graphite which is attached to the fuel part. The cladding is made from fibrous or fabric-like carbon material. (FR)

1588 NUCLEAR REACTOR. Patarin, L. (to Commissariat a l'Energie Atomique). French Patent 2,119,812. 11 Aug 1972. Filed date 15 Oct 1970. 7p. (In French).

A high temperature nuclear reactor is described. In this reactor the active core, the reflector, the lateral and axial shields, and the floor supporting the core are made of prismatic elements stacked in columns. The dimensions of these elements correspond to a single module. (FR)

1589 IMPROVEMENTS IN AND RELATING TO NUCLEAR REACTOR FUEL ELEMENTS. Salton, D. J.; Emsley, G. M. (to Nuclear Power Group Ltd.). English Patent 1,296,554. 15 Nov 1972. Filed date 19 Jun 1969. 3p.

Fuel elements are assembled in end to end relationship to form a stack or stringer, the assembly being carried by a tie-bar passing through its center. During on-power loading the coolant gas forces may be sufficient to separate adjacent fuel elements, thus allowing coolant gas to by-pass some of the elements, with resultant overheating. In the system described a spring is provided to separate the tie-bar and the fuel element assembly in the axial direction. The spring may be housed in an annular space formed between an outer sleeve attached to the lowermost fuel element and an inner sleeve mounted on the tie-bar, the spring engaging ledges on both inner and outer sleeves. (UK)

Power Reactors, Non-Breeding, Otherwise Moderated

Refer also to abstract 1755.

1590 (INIS-mf-86) ECONOMIC ASPECTS OF THE KS-TYPE REACTOR IN CZECHOSLOVAKIA. Cerny, A. 10p. (In Slovak). (CONF-701214-3). INIS.

From fifth conference on nuclear power; Piestany, Czechoslovakia (1 Dec 1970).

The costs per kWh produced in the A-1 power station are analyzed in detail. Upon attaining the planned load factor and after reducing the fuel costs, the total costs per kWh produced will be about twice those in conventional power stations; in view of the purpose of the A-1 power station this is considered to be acceptable. (INIS)

1591 (INIS-mf-123) PROPAGATION OF PRESSURE DISTURBANCES IN THE A-1 PRIMARY CIRCUIT. Kotrnoch, J.; Mlady, Z.; Pecinka, L. 12p. (In Czech). (CONF-701214-13). INIS.

From fifth conference on nuclear power; Piestany, Czechoslovakia (1 Dec 1970).

A brief description is given of equipment failures in the primary circuits of nuclear power stations abroad, resulting from the effect of multi-cyclic phenomena. Propagation of pressure disturbances in the primary circuit of the A-1 power station is analyzed, and a piezo-electric sensor is described which has been developed

for the measurement of pressure, temperature, and coolant flow rate between the turbo-compressor discharge and the cool gas chamber. (INIS)

1592 FUEL LATCH. Janusz, S. A.; Lloyd, R. E.; Cashen, W. S.; McConkey, K. N. (to Canadian General Electric). Canadian Patent 905,020. 11 Jul 1972.

The novel device is useful in natural-uranium nuclear reactors that employ uranium dioxide fuel located within pressure tubes in a calandria containing heavy-water moderator. Such reactors are fuelled at power by means of fuelling machines attached to both ends of the fuel channels. Latches are used to hold the fuel bundles in place against coolant pressure and possibly also against gravity (if the fuel channels are vertical). The improved latches described consist of annular pivoted segments, held in open or closed position by means of springs and cams. A latch is normally pushed open by incoming fuel, and the improved design reduces wear. For defuelling, a latch can be held open by an attachment on the fuelling machine. (CA)

1593 NUCLEAR REACTORS. (to Atomic Energy of Canada Ltd.). British Patent 1,298,600. 6 Dec 1972. Priority date 21 Apr 1969, United States of America (USA). 11p.

A system is described that provides a reactor having a higher thermal efficiency at economical fuel consumption than a reactor in which all of the coolant circulates through the core coolant tubes at substantially the same temperature and pressure range. The core has two groups of coolant tubes for heating feed water in stages to superheated steam, one group being a steam superheating group for operation at a higher internal temperature and pressure than the other group, the latter forming parallel flow paths in a different closed flow path. A third group of coolant tubes may also be employed. Flow diagrams are described. (UK)

1594 VIBRATION TESTS OF PRESSURE TUBES FOR A. T. R. Report of Vibration Tests. Iio, Hiromoto (Power Reactor and Nuclear Fuel Development Corp., Tokyo); Kaga, M.; Ishizaki, Y. Hitachi Hyoron; 54: No. 11, 967-972 (Nov 1972). (In Japanese).

The vibration tests of pressure tubes at the JATR reactor are described. The tests resulted in clarifying the vibrating characteristics of a partial model of a reactor containing full scale pressure tubes. The tests produced basic data required for seismic analysis. (auth)

1595 SITE INVESTIGATIONS FOR RAJASTHAN ATOMIC POWER PROJECT. Singha Roy, P. K. (Rajasthan Atomic Power Project, Kota, India). Indian J. Power River Valley Develop.; 22: 243-252 (Jun 1972).

The topographical, meteorological, geological and hydrographical investigations conducted at the plant site during the investigation stage of setting up Rajasthan Atomic Power Project at Kota are described. Typical data about meteorological and other data obtained during the period of 1963 to 1966 are also incorporated, which may be considered as representative records for the part of country near the power station situated at about 40 miles south of Kota on the Chambal River. (INIS)

1596 COOLING EXPERIMENT OF CALANDRIA TUBES. Sawai, S. (Power Reactor and Nuclear Fuel Development Corp., Tokyo); Kudo, T. Doryokuro Giho; No. 5, 38-42 (Aug 1972). (In Japanese).

When heavy water dumping is performed in advanced thermal reactors, it is necessary to cool calandria tubes, as the tubes are exposed in helium gas and are heated by heat transfer from pressure tubes and by gamma irradiation. Tests were performed to resolve problems such as the structure and size of the orifice, heavy water pressure before the orifice, distribution of water flow to each calandria, and assessment of calandria temperature. Test equipment was manufactured in full size for the fluid flow and heat transfer testing of single tube and a tube group. The following results were obtained. It seems adequate that diameter of the orifice is 7.5 ϕ, and flow rate for one calandria is 800 liter/hour. The relation between pressure in a flow distribution chamber and the speed of spouting is linear. The thickness of water film was 0.6 to 1.0 mm. Mixing of water in a circumferential direction was hardly observed. Heat transfer characteristics of the calandria tubes submerged in water were inferior to those of the calandria tubes with a water film on the surface. The following factors can contribute to the design of a prototype reactor: the flow distribution and pressure distribution can be estimated by concentric circle approximation; the temperature of calandria tubes may be calculated by means of ordinary heat transfer calculation; and the above mentioned values may be adopted for the shape of the orifice. (JA)

1597 HEAVY WATER CRITICAL EXPERIMENT. Sakata, H. (Power Reactor and Nuclear Fuel Development Corp., Oarai, Japan). Doryokuro Giho; No. 3, 35-44 (Feb 1972). (In Japanese).

Reactor physics experiments were performed with the DCA (D_2O critical assembly built for the experimental analysis of the "FUGEN" heavy water advanced thermal reactor), and the results are summarized. The height and diameter of the DCA core are both about half of those of FUGEN. Varying parameters such as lattice pitch, fuel enrichment (including Pu fuel) and coolant void fraction, the following experiments were performed. 1. Coolant void reactivity, with special care for the relation with geometric buckling. 2. Control rod reactivity effect, particularly the effect of mutual interference. 3. Neutron flux distribution. 4. Kinetics parameters. 5. Analysis of power peaking at the end of fuel rods and change of reactivity that is expected to occur at the time of loaded refueling. 6. Nuclear characteristics in scattered fuel charging. 7. Lattice indices (ρ^{28}, δ^{28}, δ^{25}) within fuel clusters. (JA)

Power Reactors, Breeding

Refer also to abstracts 578, 1581, 1637, 1638, 1674, 1748, 1758, 1767, and 1790–1792.

1598 (AI-AEC-13055) SOFIRE II USER REPORT. Beiriger, P.; Hopenfeld, J.; Silberberg, M.; Johnson, R. P.; Baurmash, L.; Koontz, R. L. (Atomics International, Canoga Park, Calif.). 30 Mar 1973. Contract AT(04-3)-824. 103p. Dep. NTIS $3.00.

A description of the SOFIRE II model is presented which is consistent with existing experimental data and can be used in establishing the capability of containment-related design features of LMFBR's. A detailed justification of the model and the application of various model assumptions and parameters to accident conditions is described. This model, in both one- and two-cell versions, is available from the Argonne National Laboratory Code Center. (auth)

1599 (ANL/EBR-74) LOADING DIAGRAMS OF EXPERIMENTAL SUBASSEMBLIES STARTING IRRADIATION IN EBR-II RUNS 51-62. EBR-II Project. Case, J. C. (comp.) (Argonne National Lab., Idaho Falls, Idaho). Mar 1973. Contract W-31-109-eng-38. 85p. Dep. NTIS $6.25.

The loading diagrams for all experimental subassemblies as they were fabricated for irradiation starting in EBR-II runs 51 through 62 are given. Each diagram, with its accompanying table, gives the location, identification number, and content of each capsule (or element) in the subassembly. The arrow on each diagram shows the direction to the EBR-II core center at the time of the initial loading of the subassembly into the reactor grid. Information with each diagram gives the type of hardware, orifice size, results of flow-testing of the fabricated assembly (where applicable), date and place of assembly, and date placed into the reactor. (auth)

1600 (CEA-CONF-2216) DEVELOPMENT OF THE PHENIX REACTOR SHIELDING. Culambourg, J.; Devillers, C.; Le Dieu de Ville, A.; Nimal, J. C. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). [nd]. 9p. (In French). (CONF-721018-15). Dep. NTIS (U. S. Sales Only) $3.00.

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

The shielding studies associated with the development of the Phenix reactor project from the initial stage up to its final realization are presented. The choice of material and the solutions adopted are discussed. The shielding calculations utilized are cited together with the experiments undertaken. The hypotheses assumed in the contamination calculations, the problem of implanting control chambers, and the principal tests envisaged at the start-up of Phenix are briefly examined. (FR)

1601 (EURFNR-1031) FAST BREEDER PROJECT. Status Report, 1972. (Kernforschungszentrum, Karlsruhe (West Germany)). May 1972. 150p. (KFK-1603; EUR-4843). Dep. NTIS $9.50.

Work performed under United States–Euratom Fast Reactor Exchange Program.

The 1972 status of the SNR-300, a fast breeder reactor developed as a joint effort by the Debenelux countries is described. Design criteria have been established, experimental evaluations continued and proved the soundness of the design, contractural terms for construction of a prototype were agreed to, and project costs were assessed. Information is included on research and development programs related to SNR construction, future pros-

pects for fast breeder power plants, the participation of the individual countries in the joint project, status of fuel element development, development work on structural materials, and reactor safety. (LCL)

1602 (GEAP-12355) THERMODYNAMIC DATA PROGRAM INVOLVING PLUTONIA AND URANIA AT HIGH TEMPERATURES. Quarterly Report No. 20, May 1–July 31, 1972. Aitken, E. A.; Dutina, D.; Adamson, M. G.; Evans, S. K.; Ludlow, T. E. (General Electric Co., Pleasanton, Calif. Vallecitos Nuclear Center). Aug 1972. Contract AT(04-3)-189. 14p. Dep. NTIS $4.00.

Progress is reported on the continuing scope of work related to fission product cladding interactions, sodium fuel chemical interactions, and O:M and Pu:U redistribution. (auth)

1603 (GEAP-13915) SEFOR FUEL EXAMINATION RESULTS. Derby, S. L. (comp.) (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Dec 1972. Contract AT(04-3)-540. 105p. AT $5.45.

For Southwest Atomic Energy Associates.

SEFOR fuel rods were examined both destructively and nondestructively. Nondestructive examinations of standard fuel rods and guinea pig fuel rods (30% higher power density than standard rods) showed no cladding distortion after repeated power transients, including super-prompt critical tests from 8 MW. Radiographic examination of guinea pig rods showed no axial displacement of fuel pellets on fuel rod components from the original design specification even after repeated transient testing. No cladding I. D. attack was observed in destructive examinations of guinea pig rods exposed to .1 at. % burnup (maximum exposure). A single zone of restructured fuel was observed with slight Pu concentration at the outer radius of the restructured fuel. (auth)

1604 (GEAP-13928) EVALUATION OF IRRADIATED FUEL RODS WITH PULSED EDDY CURRENTS. Asamoto, R. R.; Bacon, R. F.; Conti, A. E.; Wozadlo, G. P. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Dec 1972. Contract AT-(04-3)-189. 62p. Dep. NTIS $5.45.

Fuel rods irradiated to 55,000 MWd/t in EBR-II were nondestructively inspected, utilizing pulsed eddy currents. The data were evaluated, and metallography of suspect areas was investigated. Correlations were made between pulsed eddy current signals and irradiation-related occurrences observed in the mixed-oxide (uranium-plutonium), stainless-steel-clad fuel rod. The pulsed eddy current technique employed indicated the radial location of discontinuities on the fuel cladding wall, showing the axial and angular orientation of the discontinuity, and was sensitive to surface irregularities 0.006 mm (0.2 mil) in depth. The pulsed eddy current system provides a powerful nondestructive tool for effectively characterizing and economically aiding in the evaluation of irradiated fuel rods prior to destructive examination or on an interim basis. (auth)

1605 (GU-5288) UNRESTRAINED SWELLING AND FISSION GAS RELEASE OF FAST REACTOR FUELS. (Gulf United Nuclear Fuels Corp., Elmsford, N.Y.). Dec 1972. Contract AT(11-1)-3059. 58p. AT $5.45.

The experiments described mark the first attempt to measure the truly unrestrained swelling characteristics of various types of potential fast reactor fuels in instrumented assemblies. The experiments were irradiated in the Douglas-United Nuclear Irradiation Testing Facility to burnups of 4.9×10^{20} and 7.0×10^{20} fiss/cm^3. Results of the unrestrained swelling tests were: the mixed carbides swelled at a $\Delta v/v\%$ of ~2.4% per 10^{20} fiss/cm^3 at 1300°C. (In comparison, the restrained swelling rate of carbides at typical LMFBR temperature gradients has been found to range between 0.6 and 0.9% $\Delta v/v$ per 10^{20} fiss/cm^3.); at a temperature of 1300°C, the unrestrained swelling rate of the mixed carbides is ~1.6 times as great as that of the mixed oxides; and the mixed-oxide unrestrained swelling rate at 1600°C is ~1.7 times greater than that at 1300°C. The tests confirm that unrestrained swelling rates of both oxides and carbides are considerably higher than swelling rates of fuels restrained by cladding. Results of the fission gas release tests show that at 1300°C an average release of 18% of theoretical was recorded for the 84% of theoretically dense monocarbide, while fuel materials with densities of ≥90% released less than 8% of theoretical at the same operating temperature. The complex experimental assembly worked well. Thirteen of the 18 fuel specimens tested operated at the design temperatures. Forty-six of the 54 high temperature thermocouples remained operational over the duration of the irradiation. (auth)

1606 (LA-5193-PR) ADVANCED PLUTONIUM FUELS PROGRAM. Quarterly Progress Report, October 1–December 31, 1972. Baker, R. D. (comp.) (Los Alamos Scientific Lab., N. Mex). Feb 1973. Contract W-7405-eng-36. 31p. Dep. NTIS $4.00.

The radiation testing results are presented for LMFBR fuel elements of PuO_2–UO_2, PuN–UN, and PuC–UC. (DCC)

1607 (ORNL-TM-4073) FAST REACTOR EXPERIMENTAL SHIELDING MONTHLY PROGRESS REPORT FOR OCTOBER AND NOVEMBER 1972. 189a No. 10028, Activity No. 40 01 03 1. Clifford, C. E.; Muckenthaler, F. J.; Stevens, P. N. (Oak Ridge National Lab., Tenn). Jan 1973. Contract W-7405-eng-26. 61p. AT $5.45.

Experimental results are presented for γ radiation measurements in LMFBR shielding mockups in the Tower Shielding Facility. (DCC)

1608 (ORNL-TM-4127) FAST REACTOR EXPERIMENTAL SHIELDING MONTHLY PROGRESS REPORT FOR DECEMBER 1972. 189a No. 10028, Activity No. 40 01 03 1. Clifford, C. E.; Muckenthaler, F. J.; Stevens, P. N. (Oak Ridge National Lab., Tenn.). Mar 1973. Contract W-7405-eng-26. 29p. AT $4.00.

Experimental results are presented for γ radiation measurements in LMFBR shielding mockups in the Tower Shielding Facility. (DCC)

1609 (ORNL-TM-4164) FAST REACTOR ANALYTICAL SHIELDING MONTHLY PROGRESS REPORT, NOVEMBER–DECEMBER 1972, 189a No. 10318, ACTIVITY No. 40 01 03. Mynatt, F. R.; Gritzner, M. L.; Maerker, R. E.; McGregor, B. J.; Childs, R. L. (Oak Ridge National Lab., Tenn.). Mar 1973. Contract W-7405-eng-26. 65p. AT.

Experimental results and calculations for neutron flux and γ radiation in LMFBR shielding mockups are compared. (DCC)

1610 (ORNL-TM-4170) FAST REACTOR EXPERIMENTAL SHIELDING. Monthly Progress Report, January 1973, Activity No. 40 01 03 1, 189a No. 10028. Clifford, C. E.; Muckenthaler, F. J.; Stevens, P. N. (Oak Ridge National Lab., Tenn.). Mar 1973. Contract W-7405-eng-26. 49p. AT $4.00.

The progress made by the ORNL Neutron Physics Division in Fast Reactor Experimental Shielding Research during January is summarized. The FTR gamma-ray experiment was completed during this period, and the majority of the data for this experiment is reported. Development of improved techniques for the utilization of TLD dosimeters, primarily calcium sulfate type, is described, as well as experimental results taken with the TLDs in the spectrum modifier — 22-in. iron configuration. (auth)

1611 (ORNL-TM-4203) FAST REACTOR EXPERIMENTAL SHIELDING MONTHLY PROGRESS REPORT FOR FEBRUARY 1973. 189a No. 10028, Activity No. 40 01 03 1. Clifford, C. E.; Muckenthaler, F. J.; Stevens, P. N. (Oak Ridge National Lab., Tenn.). Apr 1973. Contract W-7405-eng-26. 88p. AT $5.45.

Progress in fast reactor experimental shielding research during February 1973 is reported. The Westinghouse ARD demonstration plant side shield experiment was initiated. Neutron and gamma-ray spectral measurements were completed for the spectral modifier followed by 5-, 10-, and 15-in. thick UO_2 radial blanket configurations, as well as for several shielding configurations of sodium and stainless steel which were preceded by a spectral modifier and a 10-in. thick UO_2 blanket. (auth)

1612 (RD/B/N-1423) ACOUSTIC DETECTION OF GAS BUBBLES IN LIQUID SODIUM. Hayes, D. J. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Aug 1969. 22p. Dep. NTIS (U. S. Sales Only) $3.25.

The effects of gas bubbles on ultrasonic fields in liquids and the induced generation of noise by bubbles are discussed with particular reference to the detection of hydrogen and inert gas bubbles in liquid sodium coolants. (auth)

1613 (WARD-3045-T-2-B-9) DESIGN ANALYSIS OF THE LMFBR RADIAL BLANKET. Bishop, E. C. (Westinghouse Electric Corp., Madison, PA. Advanced Reactors Div.). Mar 1973. Contract AT(11-1)-3045. 154p. AT $7.60.

A review of the state-of-the-art of Liquid Metal Fast Breeder Reactor (LMFBR) radial blanket design and development is presented. The expected environmental conditions in the radial blanket region are described. A detailed discussion of the radial blanket nuclear, mechanical, thermal, and hydraulic design bases is presented. The uncertainties in the design parameters are discussed qualitatively and quantitatively. Analytical and experimental methods which could reduce the design uncertainties are presented and evaluated. The wide range of operating conditions of the radial blanket assemblies and their unique design differences from core assemblies necessitates experimental data in several critical design areas. These include: (1) improvement of thermal and hydraulic analytical models utilizing out-of-pile sodium flow tests

of heated rod bundles; (2) irradiation tests of fuel rods and of a complete radial blanket assembly in a fast flux environment; (3) development testing of a radial blanket flow control system; and (4) selected mechanical tests of assembly strength and stiffness. Of these, a proposed irradiation test of seven radial blanket fuel rods in EBR-II is discussed in detail. The appendices list radial blanket design requirements and define working stress classifications and structural design limits appropriate for radial blanket design. The descriptive part of the Final Design Description Report of the proposed irradiation test in EBR-II is included. (auth)

1614 (WARD-3045-T-4-A-6) RADIAL BLANKET AND SHIELD SIMULATION EXPERIMENTS QUARTERLY PROGRESS REPORT FOR PERIOD ENDING JANUARY 31, 1973. Rittenberger, R. V. (Westinghouse Electric Corp., Madison, PA. Advanced Reactors Div.) Mar 1973. Contract AT(11-1)-3045. 40p. AT $4.00.

Experimental programs carried out to obtain sufficient technology to allow confident prediction of the shielding requirements for liquid metal fast breeder reactors are described. The measurements made in three radial blanket shield assemblies in the Tower Shielding Facility are presented. 8 references. (DCC)

1615 PERFORMANCE CHARACTERISTICS FOR OPTIMIZED CORE MODULE OF LIQUID METAL FAST BREEDER REACTOR. *Minakuchi, S. Ames, IA; Iowa State Univ. (1972). 337p.* University Microfilms Order No. 73-3914.

Thesis (Ph. D.).

A geometrically optimized core-blanket system for a 1000 MW(e) LMFBR is designed. The system is composed of one inner core, four outer cores, one inner radial blanket, one outer radial blanket, and separating blanket regions. The breeding ratio of this system is optimized (maximized) with these four variables: radius of the inner core, thickness of the inner blanket, radial length of the outer core, and angle of the separating blanket. The analysis model is convenient for comparing two representative geometries of LMFBR's. If the radius of the inner core is taken to be zero, the system has a 4-module shape. If the radial length of the outer core is taken to be zero, the system has a typical pancake (flat cylinder) shape. The systems are PuC-UC fueled. The criticality calculations are performed using the 2-dimensional diffusion theory code, 2DB, generating flux profiles and breeding ratio information. This computer code is modified for use on an IBM 360/65. In order to proceed with the geometrical optimization, the breeding ratio is represented with a function derived by a dimensional analysis (Pi-theorem) technique, and then an ordinary optimization method is applied to this empirical function. The new technical process of the core design optimization is developed, and its feasibility is proved with its technical simplicity and economical calculations. Typical pancake shape and 4-module systems are designed with the same design conditions used for the optimized system. Their geometrical parameters roughly correspond to the commercial reference designs of the pancake shape and the 4-module reactor cores. (Diss. Abstr. Int., B)

1616 *NUCLEAR REACTORS. Jackson, G. O. (to United Kingdom Atomic Energy Authority).* U. S. Patent 3,715,270. 6 Feb 1973. Priority date 30 Jan 1968, United Kingdom of Great Britain and Northern Ireland (UK). 12p.

A large power-producing nuclear reactor of the liquid metal cooled fast breeder type, with its coolant circuitry submerged in a liquid metal pool in a vault, has an enclosed core and coolant circuit loops communicating with the core enclosure at opposed ends. The core enclosure also contains radial neutron shielding and one end neutron shielding and consists of an open-topped vessel whose top is closed by a lid which incorporates a part of neutron shielding for the end. The remaining part of the end neutron shielding consists of the vault roof. The vessel lid is preferably connected to a co-axial rotatable part of the vault roof for rotation and outward axial movement. The reactor tank preferably has a minimum width in the region where the core is located so as to provide holddown structure with minimum span. (*Official Gazette*)

1617 DISMANTLING MACHINE PRINCIPALLY INTENDED FOR NUCLEAR FUEL ASSEMBLIES. Bernard, J.; Kergoat, A.; Gaudefroy, J.; (and others). (to Commissariat a l'Energie Atomique). French Patent 2,108,132. 19 May 1972. Filed date 24 Feb 1970. 24p. (In French).

A dismantling machine for the fissile or fertile fuel assembly of a fast Na cooled reactor is described. The machine possesses a cylindrical base which can be joined to a metallic cladding enclosing a series of parallel pins made of fissile or fertile material. This machine is provided with an elongated metallic chassis, a hollow work bed, and a support which swings about a horizontal axis receiving the base of the fuel assembly in a cylindrical sleeve. The machine is also provided with a series of transverse cutting devices for the assembly, a longitudinal sawing device, a gripping device for pulling away the cuttings formed, and a lifting unit. (FR)

1618 SAFETY-ASSESSMENT PHILOSOPHY OF THE FAST FLUX TEST FACILITY. Nucl. Safety; 14: No. 2, 79-90(1973).

Safety has been emphasized throughout the Fast Flux Test Facility (FFTF) project as an integral part of the total project effort from the inception of design throughout all aspects of the engineering, construction, testing, operation, and maintenance of the plant. This overall concept is expressed in terms of three levels of safety. The first level addresses the prevention of accidents through the intrinsic features of the design of the plant and the quality, redundancy, testability, inspectability, and fail-safe features of the components of the reactor and plant. The second level concerns providing protection against such incidents as reactivity insertions or failures of parts of the control system which might occur in spite of the care taken in design, construction, and operation to prevent them. The third level of safety supplements the first two through features that add margin in the plant design as additional assurance that protection to the public is provided even in the event of the occurrence of extremely unlikely and unforeseen circumstances. Also included in the discussion are the principal FFTF design parameters and the reactor's inherent safety features, the programs of testing and development to support the design, and the care used in construction and testing. (auth)

1619 STEAM GENERATORS FOR SODIUM-COOLED FAST BREEDER REACTORS. State of Development and Design Guide. *Nakagawa, H.; Omori, Y.; Kanai, T.; Ogasawara, H.; Miki, R.* Tokyo; Japan Society of Mechanical Engineers (1971). 243p. (In Japanese).

In Na-cooled FBRs, an intermediate Na loop is placed between the primary Na coolant system and the steam system to prevent large reactivity due to the moderation of neutrons by mixing water in the primary Na system and to avoid the diffusion of primary Na to the outside. The steam generators which are employed are heat exchangers between the Na and the water systems. Na is corrosive, and reacts violently and exothermically with water. High temperature, pressure, and chemical reactions destroy evaporation tubes around leaking points, accordingly mechanisms to prevent leakage is most important in power generation plants. The steam generators operated heretofore had double-walled heating tubes, but these are disadvantageous because of cost and efficiency. The development of a single-walled type is being investigated. An estimation of the economy of the steam generators is presented. Development in various countries of steam generators is summarized for testing reactors, experimental reactors, and prototype reactors. Problems in design, welding techniques, thermal expansion, thermal shock and thermal stress, vibration, flow instability, overall heat transmission rate, and dryout; problems in material selection, corrosion, erosion, mass transfer, decarbonization and carburization, characteristics of stabilized ferrite steel and wear due to the Na-water reaction; problems in water quality control, purity of Na, difficulty in inspection and repair, and detection of the Na-water reaction and leakage; and problems in inspection methods were evaluated. Testing facilities for the steam generators in various countries are described. (JA)

1620 BOON TO SOCIETY: THE LMFBR. Creagan, R. J. (Westinghouse Electric Corp., East Pittsburgh, PA). Mech. Eng.; *95: No. 2, 12-16(Feb 1973).*

The LMFBR provides benefits to the world in terms of greatly increased energy resources. The additional energy supplements the fossil-fuel energy reserves and greatly increases the potential for production of useful power from the nuclear-energy reserves already available. A cost-benefit analysis by the AEC indicates benefits to the U. S. over a 34-year period of $21.5 billion, discounted at 7 percent to mid-1971. The high temperatures involved provide greater thermal efficiency, which reduces the effect of heat rejection to the environment. (auth)

1621 EFFECT OF SODIUM ON MECHANICAL PROPERTIES AND FRICTION-WEAR BEHAVIOR OF LMFBR MATERIALS. Natesan, K. (Argonne National Lab., IL); Kassner, T. F.; Li, C. Y. *Reactor Technol.; 15: No. 4, 244-277(Win 1972).*

The status of materials-sodium compatibility information for the liquid-metal-cooled fast breeder reactor is reviewed, with emphasis on mechanical behavior. An attempt was made to correlate the creep-rupture properties of unstabilized austenitic stainless steels exposed to sodium with available data obtained in air or inert-gas environments based on the composition, microstructure, and thermal history of the materials. Information on the degradation of the mechanical behavior due to fast-neutron irradiation is included for comparison with the data in a sodium environment. The adhesion, wear, and friction properties of materials in sodium are also reviewed. Requirements are summarized

for additional materials-properties information in a sodium environment to reduce the uncertainties in the safety factors applied to present design data. (auth)

1622 NUCLEATION OF LIQUID SODIUM IN FAST REACTORS. Fauske, H. K. (Argonne National Lab., IL). Reactor Technol.; 15: No. 4, 278-302(Win 1972).

Analytical models and experimental studies pertaining to superheating of liquid sodium including both homogeneous and heterogeneous nucleation are reviewed. Their applicability to analysis of hypothetical fast reactor accidents including channel voiding in relatively intact core geometry, as well as violent boiling due to molten fuel–coolant interaction, is discussed. (auth)

1623 EFFECTS OF OXYGEN CONCENTRATION ON PROPERTIES OF FAST REACTOR MIXED-OXIDE FUEL. Johnson, C. E.; Johnson, I.; Blackburn, P. E.; Crouthamel, C. E. (Argonne National Lab., IL). Reactor Technol.; 15: No. 4, 303-338(Win 1972).

The effects of O concentration on properties of fast reactor mixed-oxide fuels are assessed. The differences in fission-product yields from either ^{235}U or ^{239}Pu fission greatly affect the O potential. For fast fission, ^{235}U produces higher yields of oxide formers, whereas ^{239}Pu produces higher yields of noble metals. The effects of O and Pu concentrations on thermal conductivity of ceramic fuels are examined. Increases in O and Pu concentrations appear to produce increases in the thermal conductivity. A mathematical model for predicting the O potential is described and compared with mass-spectrometric measurements. Excellent comparisons are found for the urania and mixed urania–plutonia systems. The influence of the O potential on actinide, oxygen, and fission-product transport in irradiated fuels is discussed. A method utilizing the Mo–MoO_2 indicator couple is given for evaluating the O potential in the columnar and equiaxed regions of irradiated mixed-oxide fuels. The contributions of O and fission products, especially cesium, to cladding corrosion are evaluated. The cladding acts as an O sink, thereby increasing during the irradiation of the fuel. The effect of O potential on the sodium–fuel reaction, in the event of a cladding breach, is examined. (auth)

1624 NUCLEAR FUEL ASSEMBLY. Cayol, A.; Chalony, A.; Clottes, G.; Praizey, J. P.; Skok, J.; Venobre, H. (to Commissariat a l'Energie Atomique). French Patent 2,115,002. 7 Jul 1972. Filed date 20 Nov 1970. 11p. (In French).

This nuclear fuel assembly for liquid metal (Na) cooled breeder reactors possesses at least one bundle of clad fissile or fertile fuel pins positioned in a regular lattice inside a fluid cooled envelope. Each pin is provided with a helically wound spacing wire along most of its length, this wire fixing the distance between a pin and its neighboring pins or the envelope. The wires corresponding to pins at the edge of the bundles are provided with radial protrusions which press against the envelope. The protrusions corresponding to the wires of pins at the center of the bundle are smaller than those corresponding to the wires of pins at the edge of the bundle. (FR)

1625 FAST REACTOR. Grishanin, E. I.; Murogov, V. M.; Orlov, V. V.; Tocheny, L. V. British Patent 1,299,038. 6 Dec 1972. Filed date 31 Aug 1971. 5p.

Fast reactors in which flattening of the heat generation profile is effected by the provision of subzones having dissimilar concentrations of fuel material (flattening by enrichment) suffer from certain drawbacks, such as a marked deformation of this profile resulting in the practical disappearance of the effect of field flattening in the course of protracted reactor operation without recharging (6 months and upwards). The instability of the heat generation field precludes utilization of prolonged continuous operation, and also results in a further impairment of the heat generation profile in the reactor core. The system described employs a fertile blanket that envelopes a core consisting of an outer and inner fissile subzone, the outer zone consisting of ^{239}Pu and inner zone consisting of ^{235}U, and the volume of the inner subzone being 20 to 90% of the total core volume. This system shows all the advantages of the enrichment flattened reactor, such as identity of fuel element design in the core subzones, and possesses such advantages as steady operation, lower heat generation non-uniformity, and a stable heat generation profile, and hence enhanced power density and breeding rate, together with reduced power cost. It is expedient to use Pu in oxide form (PuO_2–UO_2). The U may be used in metallic form. (UK)

1626 MATERIALS PROBLEMS IN BREEDER REACTORS. Shewmon, P. G. (Argonne National Lab., IL). Metal Sci. J.; 7: 36-40(Jan 1973).

A brief survey is presented of novel phenomena being studied in materials used in the cores of fast reactors. The problems encountered in the LMFBR include aspects of sodium chemistry i.e., corrosion, oxygen concentration and carbon transfer; effects of temperature gradients, swelling and fission gas release on fuel element performance; and radiation damage, especially swelling and creep in stainless steel and fission induced creep of UO_2. (UK)

1627 IMPROVEMENTS IN SODIUM COOLED FAST FISSION NUCLEAR REACTORS. Hind, J. R. (to United Kingdom Atomic Energy Authority). British Patent 1,299,192. 6 Dec 1972. Filed date 20 Feb 1969. 3p.

In Na-cooled fast reactors having a primary containment vessel for the liquid metal, under accident conditions a fuel-Na reaction can occur with the production of Na vapour and generation of high pressure in the primary containment vessel, which must be designed to be capable of withstanding such a pressure excursion. In the system described a number of gas-pressurised containers are provided, resistant to collapse under the operating pressures within the vessel; these containers are immersed in the liquid metal and arranged so that they collapse on occurrence of an accident involving the generation of Na vapour and shock waves. The containment vessel may be of circular cross section and the gas pressurised containers arranged in a circle around the inside of the vessel: or the containers may have a cylindrical body with end closures providing weakened zones to collapse by rupture and release their gas fillings. (UK)

1628 TREND OF FAST REACTOR INSTRUMENTATION. Genshi Doryoku Kenkyukai Teirei Kenkyukai Nenkai Hokokusho; No. 45, vp. (Aug 1971). (In Japanese).

An essential point of fast reactor design in the past was securing inherent safety by reactor-core shape and characteristics. Now the core shape is an ordinary one with safety-protection systems. In the LMFBR, development of in-core detection and measuring systems is important. Since it mainly monitors local core abnormality and catches abrupt changes in heat conducting surface, its major components are such process detection systems as those for outlet temperature, channel flow rate, boiling detection, pin coating failure detection and the like. Outlet temperature perturbation is considered for the detection of local over heating. Five types of channel flowmeters are considered. Boiling is detected by ultrasonic cavitation and acoustic signal. Various failed fuel detection and location methods are being studied, and seven methods are described. (JA)

1629 FRENCH NUCLEAR-POWER TEST PLANT PHENIX EQUIPPED WITH A FAST NEUTRON REACTOR. Arch. Energiewirt.; 26: No. 15, 746-753(1972). (In German).

Described are: the reactor containment and core, the basic technical equipment of the nuclear power plant, the loading and unloading of the reactor, and safety aspects of the reactor. The most important technical data of the reactor are tabulated. (GF)

1630 TEST PLAN OF SODIUM–WATER REACTION AND PRESENT SITUATION ABOUT LARGE LEAKAGE TEST. Hori, M. (Power Reactor and Nuclear Fuel Development Corp., Oarai, Japan). Doryokuro Giho; No. 3, 55-62(Feb 1972). (In Japanese).

Water leakage in steam generators in sodium cooled reactors results in sodium-water reactions. That reaction is classified into two types; reactions from large leakage and those from small leakage. The large leakage reaction is the one which causes hazardous pressure rising, and the small one is leakage from pinholes. The project on the sodium-water reaction of Power Reactor and Nuclear Fuel Development Corporation aims at advancement on the safety, reliability, and economy of the steam generator for the Monju fast breeder reactor. As test equipment, a vessel of 1/8 scale of the unit type steam generator of Monju was employed. High temperature and pressure water was injected into 100 kilograms of liquid sodium in the reaction vessel, then pressure, temperature, and strain were measured. The correlation between the water injection rate and leakage amount in the steam generator was estimated by the isovelocity model. Just after the injection, a sharp pressure spike, about 100 kilograms/cm^2, can be observed. The duration of the pressure spike is 2 to 10 milliseconds. After a Cr-Mo steel heating pipe was directly hit by the injected water for 20 seconds, it was observed that the heat pipe was eroded to depth of 2 millimeters. Development of a calculation code for the pressure in the steam generator is scheduled taking the discharge system into consideration. (JA)

1631 OUTLINE OF THE SECONDARY DESIGN OF MONJU. Odajima, K. (Power Reactor and Nuclear Fuel Development Corp., Tokyo). Doryokuro Giho; No. 5, 43-57(Aug 1972). (In Japanese).

The secondary design of "Monju" was performed by five atomic industrial groups from October 1971 to March 1972 and was ad-

justed synthetically by the Mitsubishi group. In this secondary design of "Monju," it was mostly stressed that the "Monju" must be designed as a coherent plant, and that the secondary design must give preparatory description for safety inspection. The reactor will produce 714 megawatts of thermal power and 300 megawatts of electric power. Burn-up of in-core fuel was designed to be 80,000 megawatt day/ton on an average. The plutonium breeding ratio is 1.17. The in-core fuel is plutonium-uranium mixed oxide, and the blanket fuel is depleted uranium of 0.2 wt % ^{235}U. Exchange of the fuel is performed every six months, and for the core fuel, the 5 batch dispersion method is employed. The fuel handling system is composed of an in-containment fuel exchange system, fuel loading and unloading machine, extra-reactor fuel translator, and fuel storage system. Primary and secondary main cooling systems each comprise three loops. An auxiliary cooling system has two independent loops, and is used for emergency cooling. As gas systems, two argon gas systems and nitrogen gas system are installed. Instrumentation systems were designed centering around neutron instrumentation, failed fuel detection system, and process instrumentation. (JA)

1632 KINETICS MODEL FOR FAST REACTOR DISASSEMBLY WITH FUEL-COOLANT INTERACTIONS. Mills, J. C. Los Angeles; Univ. of California (1972). 116p. University Microfilms Order No. 72-33,958.

Thesis (Ph. D.)

A computational model to study spatial and spectral effects during moderate transients including fuel-coolant interactions is presented. The transient is assumed initiated by a slow ramp reactivity insertion above prompt critical (fuel failure propagation in the central subassemblies) or a large ramp (caused by local sodium voiding). A temperature threshold is used to initiate a fuel-coolant interaction in any node. This is followed by heat-transfer, pressure generation in that channel, sodium expulsion and fuel movement caused by vapor drag. The kinetics are represented by a few group, one space dimension model derived by a synthesis scheme modeling the multigroup, two dimensional equations. The scheme correctly accounts for the space dependent effects caused by Doppler feedback, sodium expulsion and fuel movement. The results presented indicate that a meaningful picture and understanding of the dynamics of fuel-coolant interactions can be obtained with an economical but accurate space-time model. However, these same results indicate that considerable work can still be done in improving the knowledge of fuel-coolant interactions during disassembly accidents. (JWR)

1633 FISSILE MATERIAL BREEDING CAPABILITY OF A PINCH FISSION CAVITY REACTOR. D'Amico, A. R. Pittsburgh; Univ. of Pittsburgh (1972). 151p. University Microfilms Order No. 72-30,774.

Thesis (Ph. D.).

The investigation of the breeding capabilities of a pinch fission cavity reactor (PFCR) is reported. This device offers a means of producing electrical energy by a direct means as well as exhausting heat from the reactor circuit into a conventional turbine-generator system. This arrangement promises thermal cycle efficiencies greater than 45%. Another outstanding feature of PFCR is the fluid state of the fissile fuel. This feature can permit on-line chemical clean-up of fission products, thereby, reducing the fissile fuel inventory. Most important is the potential of breeding, that is, producing more fissile fuel than is consumed during the power generating operation. The PFCR model consisted of a 10% enriched ^{233}U and ^{232}Th core with a ^{232}Th blanket region. The salient consideration in determining the ^{233}U breeding phenomenon of the model were the material inventories as a function of reactor operating time. A modified version of a nuclear computer program called LEOPARD (Life-time Evaluating Operations Pertinent to the Analysis of Reactor Designs) was programmed for this purpose. The analytical procedure required the reactor to operate with the initial fuel loading at power densities of 150 and 80 kW/cc for the core and blanket, respectively for a period of 20,000 MWD/T. The optimum breeding ratio achieved was 1.3 with a doubling time of approximately 10 years. The results compare favorably with the breeding ratio and doubling time of the current liquid metal fast breeder reactor (LMFBR). (Diss. Abstr. Int., B)

1634 EXPERIMENTAL TEMPERATURE DISTRIBUTIONS IN LIQUID METAL FAST BREEDER REACTOR FUEL ASSEMBLIES: THE EFFECT OF BOWING DISTORTION. Collingham, R. E.; Yatabe, J. M.; Hill, V. R.; Thorne, W. L. (Westinghouse Hanford Co., Richland, WA). AIChE Symp. Ser.; 68: No. 118, 119-126(1972).

From 12th national heat transfer conference: Tulsa, Oklahoma (15 Aug 1971).

Experimental tests were performed in sodium with wire wrapped electrically heated seven-pin bundle assemblies typical of LMFBR geometry to determine the effect of bowing distortions. The results are presented in terms of clad and coolant temperature distributions for both bowing of a single pin and bowing of the entire bundle. (auth)

Research, Test, and Experimental Reactors

Refer also to abstracts 461, 483, 501, 614, 1679, 1693, and 1708.

1635 (ANL-7956) FISSION-PRODUCT RELEASES TO THE PRIMARY SYSTEM OF EBR-II DURING 1971. Smith, R. R.; Bunson, G. S.; Ebersole, E. R.; Fryer, R. M.; Henault, P. B.; Koenig, J. F. (Argonne National Lab., Ill.). Nov 1972. Contract W-31-109-eng-38. 54p. Dep. NTIS.

During the period March to December 1971, cladding breaches resulted in five series of fission-product releases to the primary system of EBR-II. Although the effects of the various releases were adversely reflected in plant-capacity factor, the information derived from the releases has substantially contributed to an understanding of the immediate consequences of cladding breach. Of the five series of releases, four were positively identified with specific experimental subassemblies. These were, in their order of identification, X073 and X085, which contained mixed-oxide fuel; X082A, which contained high-burnup metallic driver fuel; and X106, which contained mixed-oxide fuel. The origin of the fifth release was never positively identified. Information of an inferential nature, however, indicated the involvement of low-burnup driver fuel. As a consequence of the various releases, several "first-of-a-kind" phenomena were observed. Among these were the first occurrence of a release from an unencapsulated mixed-oxide element, the first identification of a leaker through the use of the xenon-tag technique, and the first experience with situations in which two or more fuel elements appeared to be releasing fission products at the same time. (auth)

1636 (BARC/I-168) EXPERIMENTAL INVESTIGATION INTO HEAT TRANSFER AND PRESSURE DROP FOR PULSED FAST REACTOR CORE. Kakodkar, A.; Grover, R. B. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 5p. INIS.

Details of the experimental investigations carried out to study the heat transfer and pressure drop in the core of a pulsed fast reactor to be installed at the Reactor Research Center, Madras, India, are reported. The reactor is intended to be cooled by the passage of air over the fuel pins. The feasibility of this method for effective cooling was studied and data on the pin temperatures, pressure drops and flow rates required have been collected. The set-up was made of seven pins arranged in a triangular lattice in a grid plate. Chromel-allumel thermocouples were used to measure the temperatures. Temperatures and pressures were recorded at three different flow rates for two series and for the third series, the power was varied keeping the flow rate constant. Pressure drops were also observed and it was found that they were negligible even for a power variation of 200 watts/pin. The limitations of the experiment, such as the effect of side walls on pressure drop, non-uniformity of air flow, etc., are mentioned. Observations have been found to be fairly repeatable. (INIS)

1637 (GEAP-13924) SEFOR PLANT OPERATING EXPERIENCE. Hixson, J. D. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Dec 1972. Contract AT(04-3)-540. 61p. Dep. NTIS $5.45.

The Southwest Experimental Fast Oxide Reactor (SEFOR) is a fast spectrum reactor fueled with mixed PuO_2-UO_2 and cooled with sodium. The reactor was designed and an experimental program was planned to enable the determination of the Doppler coefficient during both normal and abnormal operating conditions in a reactor having characteristics similar to large breeder reactors. The operational aspects of preoperational testing and the experimental program up to the completion of that program when plant decommissioning was begun are described. (auth)

1638 (GEAP-13929) SEFOR EXPERIMENTAL RESULTS AND APPLICATIONS TO LMFBR's. Freeman, D. D. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Jan 1973. Contract AT(04-3)-540. 72p. Dep. NTIS $5.45.

Results of the SEFOR Doppler measurements are evaluated. Uncertainty in the measured coefficient is estimated to be ±12% for a 1.3σ confidence (90% confidence that Doppler magnitude is no less than the nominal value less 12%). Expected uncertainty in calculated LMFBR Doppler feedback is ±18% if calculations are normalized to the SEFOR results. Uncertainties in delayed neu-

tron yield data tend to be biased toward increasing the measured value of the SEFOR Doppler constant, obtained using Keepin's data. Crystalline binding effects which were neglected in the early analysis of the SEFOR data also give a bias toward increasing the measured Doppler constant (~4.3% for static measurements, less for transient results). Calculations of the SEFOR Doppler constant using ENDF/B Version 3 data with the Bondarenko self-shielding approach in multigroup diffusion theory give calculated to measured ratios of 1.07 for Core I and 1.03 for Core II. The use of nominal Doppler coefficients in LMFBR hypothetical accident analysis leads to reduced rates of energy addition. (auth)

1639 (JAERI-M-4752) REPORT ON THE OPERATION, UTILIZATION, AND TECHNICAL DEVELOPMENT OF RESEARCH REACTORS AND HOT LABORATORY. (Japan Atomic Energy Research Inst., Tokyo). Mar 1972. 214p. (In Japanese). NTIS (U. S. Sales Only).

The Division of Research Reactor Operation is engaged in the operation, maintenance, etc. of JRR-2, JRR-3 and JRR-4 (Japan research reactors), and of the Hot Laboratory for post-irradiation tests of reactor fuels and materials. Other works in addition to the operation and maintenance are also performed, including the control of water and gas, radiation control, and irradiation. Research and development work on the technology of research reactors continues. Research is in progress on the deposition of fission products using TLG-1 gas loop. In the Hot Laboratory, fuel and materials of the JAPCO's power reactor are monitored and post-irradiation tests of various fuels are being developed. Activities during fiscal 1970 (April to March) including the problems encountered and procedures applied to solve them are described. (auth)

1640 (PTUM-FRM-104) TIME SLOPE OF CHANGES OF THERMAL NEUTRON FLUX DENSITY AT THE CORE AND BEAM TUBES OF THE FRM. Knopf, K.; Ledes, H. (Technische Universitaet, Munich (West Germany)). Aug 1970. 14p. (In German). INIS.

The neutron counting rate of the beam tube F2 has been measured with a BF_3 proportional counter tube and recorded. A calorimeter probe has been used to measure the neutron flux profile at the F-side of the reactor core. The influence of various shim rod positions has been established by a series of measurements on different rod positions. (INIS)

1641 EXPERIMENTAL DETERMINATION OF DIFFERENTIAL FAST NEUTRON SPECTRA IN A REACTOR USING THRESHOLD DETECTORS. Kim, D. H. (Atomic Energy Research Inst., Seoul). J. Korean Nucl. Soc.; 4: No. 4, 280-293(Dec 1972).

The differential fast neutron spectra above 0.5 MeV at particular spatial positions in the reactor (TRIGA MARK-II) core has been determined experimentally using several threshold activation detectors. The series expansion technique utilizing the concept of least squares optimization was used to obtain an approximate solution to the set of integral equations which are defined by the experimentally determined activation data. The influence of use of different weighting functions in the solution was analyzed in each measurement. To carry out the necessary mathematical calculations, a computer code for the UNIVAC 1106 digital computer has been prepared. Good agreement was achieved between the differential fast neutron spectra determined and the computed flux determined independently using space-independent multigroup transport theory. (auth)

1642 UTILIZATION OF PULSED REACTORS. Hirata, M. (Japan Atomic Energy Research Inst., Tokai); Ohno, Y.; Yamada, Y.; Yoshihara, K.; Yasukawa, T. pp 76-114 of Investigation of Repetitive Fast Pulsed Reactor. Tokyo; Atomic Energy Society of Japan (1972). (In Japanese).

Expected applications of pulsed reactors in various fields of science and technology are discussed and the need for pulsed reactors is explained. The application to nuclear physics, including precise measurement of neutron cross-section and resonance parameters, study of resonance absorption, and other reactions such as n-n scattering or n-e reaction are discussed. The application to solid state physics is also discussed with emphasis upon the study of the electron-excited state of about 0.1 to 1 eV. From the field of chemistry, the study of radiochemistry, activation analysis with pulsed neutrons and applications to radiation chemistry and molecular science are discussed. The application to the fields of biology and medical science is discussed mainly from the viewpoints of the intensity of neutron flux and the conditions of irradiation such as time, temperature, fluctuation of dosage, etc. From the field of material science, the study of radiation damage is expected to be developed by the use of pulsed reactors. Finally, from the field of reactor physics and engineering, accurate measurement of neutron cross-sections in the intermediate energy range and research on fuel rupture are expected to be developed with pulsed reactors. (JA)

1643 PRELIMINARY DESIGN AND INVESTIGATION OF MEDIUM SIZED REPETITIVE FAST PULSED REACTORS. Oyamada, M. (Tohoku Univ., Sendai); Kimura, M.; Watanabe, N.; Fuketa, T.; Yamamuro, N. pp 8-75 of Investigation of Repetitive Fast Pulsed Reactor. Tokyo; Atomic Energy Society of Japan (1972). (In Japanese).

Design of a medium sized repetitive fast pulsed reactor is given, followed by the reference data of similar pulsed reactors such as SORA, IBR and IBR-2. Several problems which are important for the design of the medium sized pulsed reactor are discussed separately. The first problem is a linear accelerator. Merits of a travelling-wave electron linac are discussed and compared with other types. The second problem is fundamental components and structural design of the reactor. The problem is discussed separately for core, cooling system, beam target and rotating reflector. As a result of these investigations, the fundamental structural design is proposed for the present project. Other problems discussed include: development of nuclear design techniques, such as cross-section sets, transport codes and bench mark analysis; dynamic analysis and control methods; fuel and other materials; and moderator materials appropriate for the generation of thermal and cold neutron pulsed beams. (JA)

1644 STUDIES ON RECHARGING THE ROSSENDORF RESEARCH REACTOR (WWR-SM). Adam, E.; Barz, H. U. (Technical Univ., Dresden). Kernenergie; 15: No. 6, 186-189(Jun 1972). (In German).

To increase the power of the Rossendorf research reactor (WWR-SM) a new type of fuel element was used that enables recharging. The results of calculations for various regimes of recharge are presented. For an optimum version, the changes in neutron flux density in the different regions of the reactor and the nuclide concentrations in the discharged fuel assemblies are given as a function of energy removal from the core. (auth)

1645 CALCULATED CRITICAL MASSES FOR SPHERICAL PLUTONIUM CORE WITH VARIOUS SPHERICAL REFLECTORS. Kim, D. H. (Atomic Energy Research Inst., Seoul). J. Korean Nucl. Soc.; 4: No. 4, 273-279(Dec 1972).

Requirements necessary for the construction of a fast critical assembly are briefly reviewed. The critical masses of a spherical plutonium core with various spherical reflectors and its thicknesses are calculated using 1DX, which is a computer code written for fast reactor analysis. The compilation of this code was made on the CDC 3300/Master and the UNIVAC 1106/EXEC 8. The calculated results are completely depicted and compared with other results. The Russian formatted 29 group cross section set generated by ETOX-2 using ENDF/B Version II file at Hanford is used in the calculations. (auth)

1646 POWER INCREASE OF THE IRT RESEARCH REACTOR AT THE INSTITUTE OF NUCLEAR ENERGY, ACADEMY OF SCIENCES, BELORUSSIAN SSR. Krasin, A. K.; Kokhonov, M. F.; Nesterenko, V. B.; Strelkov, G. I. (Inst. of Nuclear Energy, Minsk). Vestsi Akad. Navuk Belarus. SSR, Ser. Fiz.-Energ. Navuk; No. 2, 33-35(1972). (In Russian).

The IRT research reactor was taken to a power level of 2000 kW in 1962. In 1971 extensive modification was undertaken and within a year the reactor reached the projected power level of 4000 kW. The parameters of the reconstructed assembly are tabulated. (KSW)

1647 CONTEMPORARY RESEARCH REACTORS. Khristoforova, R. F. (Inst. of Nuclear Energy, Minsk). Vesti Akad. Navuk Belarus. SSR, Ser. Fiz.-Energ. Navuk; No. 3, 20-27(1972). (In Russian).

The physical and technical features are described for the Soviet high-flux reactors RFT, VVR, SM-2, IRT-M, MIR, and MR. 21 references. (auth)

1648 NEW INSTRUMENTATION, WITH SPECIAL REFERENCE TO THE HIGH FLUX REACTOR ILL. Maier-Leibnitz, H. (Institut Max von Laue-Paul Langevin, Grenoble, France). pp 681-696 of Neutron inelastic scattering, 1972. Vienna; International Atomic Energy Agency (1972).

From fifth IAEA symposium on neutron inelastic scattering; Grenoble, France (6 Mar 1972). See STI/PUB-308; CONF-720304-.

Developments for instrumentation at the high flux reactor in Grenoble are reviewed. Neutron guide tubes are a confirmed means of collimation. Polarizing guide tubes are not quite satisfactory. Much work has been done on monochromator crystals. Graphite and Be crystals are available in better quality for high

intensities at moderate resolution. Bent crystals have been produced by applying a thermal gradient, by diffusing layers onto one side of thin crystals, and by growing crystals of alloys with a concentration gradient. Such crystals have advantages for tailoring neutron beams. Bragg reflection of gamma rays has been used to investigate the mosaic structure of thick crystals. Heusler's alloy has been found to be a good polarizing crystal. Localizing counters are now in successful operation. Systems of BF_3-filled ionization chambers with split electrodes have been developed for use as one- or two-dimensional multidetectors. Progress has been made with scintillation detectors and detecting systems, including pulse discrimination. The theory of the triple-axis spectrometer has been worked out for flat or curved crystals as monochromators and analysers. In a system which does not use Soller collimators but allows variation of arm lengths in the triple-axis systems, general conditions for "focusing" (increase of intensity without loss of resolution) have been set up, and the basis for quantitative intensity measurements has been broadened. Multidetector systems may be used with such instruments. In the triple-axis spectrometer with back-scattering, a resolution of 2×10^{-7} eV was obtained. The "inverse time-of-flight method" (chopper–flight path–sample–analysing crystal–multidetector) has been successfully established. The method of pseudostatistical pulsing has found its place. It is especially useful for the suppression of unwanted background such as an unpolarized neutron component in pulsed polarized neutron experiments. Progress has been made with magnetically pulsed crystals. A comparison has been made of the possibilities for experiments with a continuous reactor (mostly triple-axis-spectrometer) and a pulsed reactor (time-of-flight-spectrometer). (auth)

Production and Materials Testing and Processing Reactors

1649 (AE-468) NEUTRON ABSORBER TECHNIQUES DEVELOPED IN THE STUDSVIK R2 REACTOR. Bodh, R.; Sandklef, S. (Aktiebolaget Atomenergi, Studsvik (Sweden)). Jan 1973. 27p. Dep. NTIS (U. S. Sales Only) $3.50.

The R2 is a 50 MW general purpose materials testing reactor. A large number of complicated irradiation tests are performed simultaneously in the core. To achieve specified irradiation conditions for the individual experiments it has become necessary to control the thermal neutron flux level locally. The techniques developed for thermal neutron flux attenuation are described with emphasis on the use of hafnium, silver and ^3He. The experimental arrangements are described and measured attenuation characteristics are given. Neutron transport calculations have been successfully applied to the experimental geometries and the results are discussed. (auth)

1650 (DUN-3785) USE OF IODINE-131 FOR IN-PLACE TESTING OF THE CHARCOAL FILTERS. Mecca, J. E. (Douglas United Nuclear, Inc., Richland, Wash.). 16 Feb 1968. 16p. Dep. NTIS $3.00.

The possible use of an iodine-131 tracer, an acknowledged method of charcoal filter testing, for the in-place testing of Hanford filters was investigated. It is felt that a test for leaks and efficiency of a reactor charcoal filter system using iodine-131 as a tracer is highly feasible. (auth)

1651 (DUN-3880) EVALUATION OF THE HANFORD CHARCOAL CONFINEMENT SYSTEMS. Mecca, J. E. (Douglas United Nuclear, Inc., Richland, Wash.). 15 Apr 1968. 21p. Dep. NTIS $3.25.

Very limited knowledge is available on the condition of the charcoal filter systems of the Hanford production reactors. Because of the age, the vast amounts of air effluent handled, the present physical condition of some filters, the possible contamination with pollutants capable of charcoal bed poisoning, the absence of testing and because of some recent research and findings in the area of methyl iodide creation in an accidental release, the system efficiency for the removal and retention of iodine and methyl iodide, if proved to be present, was evaluated. (auth)

1652 (JAERI-M-4867) MEASUREMENT OF GAMMA-DOSE RATE AND THERMAL NEUTRON FLUX IN THE LTFL. Okamoto, J.; Tokunaga, O.; Sato, S.; Hamanoue, K.; Sukegawa, T. (Japan Atomic Energy Research Inst., Tokyo). Jul 1972. 27p. (In Japanese).

To obtain basic data for the construction of a chemonuclear reactor, the dose rate of γ-rays and the thermal neutron flux at the irradiation position of the Low Temperature Fissiochemical Loop (LTFL) attached to JRR-3 were measured with a gaseous dosimeter and by activation analysis. The dose-rate of γ-rays and the thermal neutron flux at 7MW output of the reactor were determined to be 3×10^6 R/hr and 1.1×10^{11} n/cm^2 · sec, respectively. The dose-rate by fission fragments due to thermal neutron irradiation was measured in a capsule containing a U–Pd foil. The behavior of fission products, ^{131}I in particular, in the gaseous reactant was also examined by means of a radiogaschromatograph, and the extent of contamination of the gaseous reactant with fission products was studied and compared with the calculated value. (auth)

1653 EXPERIMENTAL SKODA REACTORS. Kott, J. Skoda Rev.; No. 4, 59-61(1972).

The Skoda reactors in Czechoslovakia, SR-0 and SR-1, used for reactor materials irradiation experiments and for train personnel to perform materials irradiation experiments are described. (LCL)

Propulsion and Package Reactors

1654 (CONF-721018-22) DEVELOPMENT OF CALCULATION METHODS AND CODES AND THEIR APPLICATION TO SPACE REACTOR SHIELDING. Amin, E.; Hehn, G.; Klumpp, W.; Ruehle, R. (Stuttgart Univ. (West Germany). Institut fuer Kernenergetik). 1972. 11p. Dep. NTIS (U. S. Sales Only) $3.00.

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

The modular program RSYST was developed to simplify the handling of various reactor and shielding problems with large data inputs and outputs. The system operates with a central data pool from which the individual modules receive data and results. A special S_N procedure is recommended for deep two-dimensional penetration problems. This procedure, which utilizes the local separation technique overcomes the ray effect by applying the first collision correction. An optimization method using dynamic programming was developed for space reactor shielding. (FR)

1655 (N-72-31779) COMPARISON OF ADVANCED PROPULSION CONCEPTS FOR DEEP SPACE EXPLORATION. Moeckel, W. E. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Sep 1972. 37p. (NASA-TN-D-6968; E-6798). NTIS.

Equations and charts are presented that permit rapid estimation of propulsion-system performance requirements for some typical deep-space missions. A number of advanced propulsion concepts for which performance estimates are available are compared with respect to their capability for flyby, rendezvous, and roundtrip planetary missions. Based on these estimates, the gas-core nuclear fission rocket and the pulsed fusion rocket yield the fastest trip times to the near planets. For round trips to Jupiter and beyond, the controlled fusion rocket shows progressively superior capabilities. Several propulsion concepts based on use of impinging laser beams are found to be noncompetitive with the other advanced concepts for deep space missions. Requirements for attainment of interstellar distances within a human lifetime are found to be some orders of magnitude beyond the capabilities of any propulsion concepts for which performance estimates are now possible. (auth)

1656 (NERC-LV-539-21) PARTICULATE EFFLUENT STUDY NRX-A6, EP-IIIA: DECEMBER 15, 1967. (National Environmental Research Center, Las Vegas, Nev. (USA)). Mar 1973. Contract AT(26-1)-539. 63p. Dep. NTIS $3.00.

The NRX-A6 Experimental Plan III was a full-power nuclear reactor operation conducted as part of Project Rover. The reactor ran from 1059 to 1159 PST, December 15, 1967 at the Nuclear Rocket Development Station, Jackass Flats, Nevada. Information is included on large particles of high activity, particle deposition density at various distances; and the gross physical characteristics, chemical composition, and gross and specific radioactivity of these particles. Surveys along arcs out to a distance of 68 miles showed a peak deposition density at 15 miles of 1 particle/10 m^2. No particles were found beyond 40 miles from the reactor. At 40 miles the peak density was approximately 4 particles/100 m^2. The particles were porous and fragile and had a metallic black appearance. Sizes ranged from two to 430μ; some consisting of up to 3 discreet particles adhering to one another. Many of the particles were shattered during collection and separation from the soil with which they were collected. The chemical composition of the particles was primarily UC_2 and various uranium oxides. In some cases alpha quartz was closely bound to the particles. The density of the material ranged from slightly less than one to 3.6. Gross activity of the particles was from 10^8 to 10^{12} fissions. Alpha activity was not determined because of the method of mounting the sample on

glass slides with collodion. The primary radioisotopes found by gamma spectroscopy were those of Sr, Zr, Ru, I, Ba, Mo, and Ce. (auth)

1657 NUCLEAR PROPULSION FOR NAVAL WARSHIPS. Hearing and Subsequent Inquiry of the Subcommittee on Military Applications of the Joint Committee on Atomic Energy, Congress of the United States, Ninety-Second Congress, First and Second Sessions, May 5, 1971–September 30, 1972. Washington, DC; Joint Committee on Atomic Energy (1972). 359p. GPO $2.25.

1658 REPORT OF JOINT EVALUATION STUDY BY JAPAN AND GERMANY CONCERNING AN 80,000 HP NUCLEAR CONTAINER SHIP. Tokyo; Japan Atomic Industrial Forum, Inc. (1972). 99p. (In Japanese).

Many studies have been made on the economy of nuclear merchant ships, and it is agreed that nuclear propulsion is advantageous in large, fast container ships, very large tankers and bulk carriers. Both Japanese and German groups decided to execute technical and economic studies on nuclear ships under an agreement in order to meet the increasing demand for high-power container ships. An 80,000 hp nuclear container ship to be used for a Europe–Far East route via Panama was designed, and technical and economic comparisons were made by both groups. The outlines of the German and Japanese nuclear ships are shown, and their main dimensions and loading capacity are somewhat different. Both ships use a pressurized water reactor of the EFDR type which was developed by Interatom. The prerequisites for the economic study are given. Prices of conventional ships and the nuclear ships were estimated by both groups. Cost reduction and the change of the construction period due to assembly-line construction were examined. The conclusion derived from the studies is that the container ship is economically promising in the Europe–Far East route, although more effort must be expended. Economy is determined by the relative price of nuclear reactors and fuel oil. Development of economic reactors is definitely important. Economic improvement will be achieved by mass production of reactors, shortening the construction period, and the solution of legislative and political problems. In order to usher in a really competitive nuclear propulsion age, a commercial demonstration ship must be constructed and operated. (JA)

1659 NEWTONIAN AND NON-NEWTONIAN LIQUIDS ROTATING ADJACENT TO A STATIONARY SURFACE. Kitchens, C. W. Jr. (Army Ballistic Research Lab., Aberdeen Proving Ground, MD); Chang, T. S. Appl. Sci. Res. (The Hague); 27: No. 4, 283-296(Feb 1973).

The interaction of a rotating flow and a stationary surface is discussed for a second-order non-Newtonian liquid. Similarity solutions of the governing partial differential equations are obtained for the case of the outer flow in solid-body rotation. The results for the Newtonian case are compared with Bödewadt's series solution of this problem. The non-Newtonian solutions indicate that for certain values of the parameters characterizing the non-linear viscous response and normal stress effects a larger secondary flow is induced in the boundary layer than in the Newtonian case. (auth)

1660 FIRST SOVIET THERMOEMISSION REACTORS. Morokhov, I. (Committee for the Peaceful Use of Atomic Energy, Moscow). J. Inst. Nucl. Eng.; 14: No. 1, 13-14(Jan 1973).

The Soviet Union carried out tests on the world's first direct conversion thermoemission reactors, Topaz 1 and 2, in 1970 and 1971. A description is given of the principles of the method and of the reactors. Under test conditions for over 1000 hours the reactors generated 5 to 10 kilowatts of electric power. The feasibility of the method has been established, and it is considered that the reactors provide a real basis for the design of thermoemission reactors and power systems using them. The salient features of thermoemission units, such as compactness, self-contained functioning and reliability, suggest that they will find their greatest applications in space power technology. It has also been suggested that thermoemission nuclear installations might find an application in underwater oil drilling. Problems to be overcome are outlined, and the need for international cooperation is stressed. (UK)

1661 RECENT TENDENCY OF MARINE NUCLEAR REACTORS. Kurabe, M. (Kawasaki Heavy Industries, Ltd., Kobe, Japan). Karyoku Hatsuden; 23: No. 9, 919-939(Sep 1972). (In Japanese).

Types, safety and performance of the marine nuclear reactors are given. Some reactor types on which various countries are engaged in research and development are described. The utility of the nuclear merchant ships can be based on long-range, large-scale, and high-speed transportation. The following ships are described; "Savannah" which carries a Shippingport nuclear plant type reactor, "Otto Hahn" which is equipped with a developed pressurized water reactor (FDR), "Lenin" which uses a PWR and is an active nuclear icebreaker, and "Mutsu" which is under construction in Japan as an experimental nuclear ship. Reactors installed on ships should satisfy the following conditions; small-size and light-weight, cheap manufacturing cost, safety, easy operation, low repair cost, high efficiency and low fuel expense. Various countries have engaged in research and development on promising reactor types such as light water, heavy water, gas-cooled, and spectral shift reactors. Among these reactor types, the spectral shift reactors are rated as most suitable for marine nuclear reactors. (JA)

Reactor Safety and Environmental Aspects

Refer also to abstracts 398, 1563, 1575, 1618, 1622, 1656, and 1882.

1662 (ANCR-1089) ANNUAL REPORT OF THE NUCLEAR SAFETY DEVELOPMENT BRANCH, JANUARY 1–DECEMBER 31, 1970. Dietz, K. A. (ed.) (Aerojet Nuclear Co., Idaho Falls, Idaho). Nov 1972. Contract AT(10-1)-1375. 389p. Dep. NTIS.

Activities of the Nuclear Safety Development Branch of Idaho Nuclear Corporation are reported for the calendar year 1970. These activities, which are part of the Water Reactor Safety Program of the United States Atomic Energy Commission, are continuing under direction of Aerojet Nuclear Company. Topics discussed are as follows: (a) LOFT integral experiments planning with emphasis on analysis to support facility design; (b) loss-of-coolant accident analysis development including thermal, hydraulic, structural, and fission product models; (c) technical assistance in reactor safety analyses in support of the Atomic Energy Commission's regulatory functions; (d) separate effects experiments including the Semiscale Blowdown and Emergency Core Cooling (ECC) Project, the Full Length Emergency Cooling Heat Transfer Projects for both boiling water reactors (BWR-FLECHT) and pressurized water reactors (PWR-FLECHT), the Scoping Emergency Cooling Heat Transfer (SECHT) Project, incipient failure detection by acoustic emission, in-plant testing in the Carolinas Virginia Tube Reactor Containment Testing Project, and fault tree analysis of the reliability of reactor safety systems. Publications prepared and distributed during the year are listed. (auth)

1663 (CEA-CONF-2198) SAFETY AND SITING OF ESTABLISHED POWER REACTOR TYPES. Tanguy, P. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). [nd]. 4p. (CONF-721109-19). Dep. NTIS (U. S. Sales Only) $3.00.

From international conference on nuclear solutions to world energy problems; Washington, District of Columbia, USA (12 Nov 1972).

Problems associated with the safety and siting of nuclear power plants are reviewed. The international aspects of reactor safety are discussed and the current situation regarding the definition of internationally agreed safety criteria is assessed. (JWR)

1664 (CENPD-89) GROWTH CONSIDERATIONS FOR LARGE HYPOTHETICAL CRACKS IN NUCLEAR REACTOR COOLANT PIPING. (Combustion Engineering, Inc., Windsor, Conn. Nuclear Power Dept.). Mar 1973. 26p.

Fracture mechanics methods are used to compute the growth of large hypothetical axial and circumferential cracks in the straight sections of the piping in the Combustion Engineering reactor coolant system. Crack growth from an assumed initial size to a size large enough to cause failure is computed as a function of the number of operating load cycles and anticipated transients. The analysis performed for this study shows that for the conservatively estimated design cyclic stresses, very large, easily detectable cracks in a straight section of piping will not propagate through the wall, and the extent of the crack growth will not be sufficient to cause failure of the piping section during the design life of the plant. Therefore, failures in straight sections of piping need not be considered as a design basis for the Combustion Engineering NSSS. (auth)

1665 (CONF-730304-6) FACTORS INFLUENCING A QUANTITATIVE SAFETY ASSESSMENT OF WATER REACTOR PRESSURE VESSELS. Witt, F. J. (Oak Ridge National Lab., Tenn.). 1972. 34p. Dep. NTIS $3.75.

From national topical meeting on water reactor safety; Salt Lake City, Utah, USA (26 Mar 1973).

The assessment of the potential of fracture, either bursting or

leaking, of water reactor pressure vessels requires both the development of a technology capable of making quantitative engineering calculations of fracture conditions and a realistic, accurate or conservative procedure for obtaining the parameters necessary for making the calculations. Most facets of both these requirements are being met by research sponsored by the USAEC's Heavy Section Steel Technology (HSST) Program. The factors affecting fracture are discussed in the context of applicability to water reactor pressure vessels. On the basis of available information, it is concluded that practically no possibility of fracture of the vessels exists for normal startup, operating and cooldown conditions. Abnormal conditions require additional evaluations but it is extremely unlikely that any such conditions, realistically taken, could lead to fracture for reasonable flaw sizes. (auth)

1666 (CONF-730304-8) PUMP MODEL FOR LOSS-OF-COOLANT ACCIDENT ANALYSIS. Farman, R. F.; Anderson, N. R. (Aerojet Nuclear Co., Idaho Falls, Idaho). 1972. Contract AT(10-1)-1375. 12p. Dep. NTIS $3.00.

From national topical meeting on water reactor safety; Salt Lake City, Utah, USA (26 Mar 1973).

An improved model to determine the dynamic response of centrifugal pumps during blowdown transients was developed for the RELAP3 code. This model is described, and results of calculations demonstrating the effect of pump modeling on the primary system hydraulic response of a pressurized water reactor are shown. The analysis indicates that pump behavior substantially influences the reactor flow rate during a LOCA. (auth)

1667 (CONF-730304-9) SCOPING STUDY OF THE EFFECTS OF CORE BLOCKAGE ON LOSS-OF-COOLANT ACCIDENT BLOWDOWN BEHAVIOR IN A PWR. Jensen, S. E.; Ybarrondo, L. J. (Aerojet Nuclear Co., Idaho Falls, Idaho). 1972. Contract AT(10-1)-1375. 13p. Dep. NTIS $3.00.

From national topical meeting on water reactor safety; Salt Lake City, Utah, USA (26 Mar 1973).

The results of a scoping study to examine the effects of core blockage on core flow resistance, core mass flow, and fuel cladding surface temperatures during a postulated loss-of-coolant accident blowdown transient in a pressurized water reactor are presented. Results for a steady state bounding analysis and transient calculations for a coupled system with a blocked core are presented and discussed. (auth)

1668 (CONF-730304-10) MOMENTUM FLUX HYDRAULIC TERMS IN DECOMPRESSION CODES. Moore, K. V.; Slater, C. E.; Ybarrondo, L. J.; Gruen, G. E. (Aerojet Nuclear Co., Idaho Falls, Idaho). [nd]. Contract AT(10-1)-1375. 15p. Dep. NTIS $3.00.

From national topical meeting on water reactor safety; Salt Lake City, Utah, USA (26 Mar 1973).

A one-dimensional transient flow equation was developed that includes an approximation to the momentum flux portion of the fundamental fluid momentum equation that describes the effects of fluid compressibility and flow area changes. Calculations from a version of the RELAP3 computer code modified to include the momentum flux terms were obtained and compared with experimental data. These comparisons showed that the accuracy of the calculations in regions of one-dimensional flow where large density gradients may exist can be increased by including the momentum flux terms in computer codes designed for the hydraulic analysis of postulated loss-of-coolant accidents in light-water nuclear reactors. (auth)

1669 (CONF-730304-11) STEADY STATE INVESTIGATION OF ENTRAINMENT AND COUNTERCURRENT FLOW IN SMALL VESSELS. Naff, S. A.; Whitbeck, J. F. (Aerojet Nuclear Co., Idaho Falls, Idaho). [nd]. Contract AT(10-1)-1375. 9p. Dep. NTIS $3.00.

From national topical meeting on water reactor safety; Salt Lake City, Utah, USA (26 Mar 1973).

An experimental investigation of countercurrent flow was performed in a series of annular configurations to aid in the development of mathematical models for describing emergency core coolant flow phenomena during a loss-of-coolant accident in a pressurized water reactor. Results are presented for downcomer annulus radial gaps varying from 0.37 to 0.62 inch and for lengths varying from 6 to 68 inches. Data obtained from these tests are presented as nondimensional volumetric fluxes and are correlated with earlier correlations based on data obtained from experiments employing tubes. Wallis' correlation for countercurrent flow in tubes was found applicable to the configurations tested. Except for very short annuli, variations in the velocity of the incoming fluid and in the length of the downcomer annulus had no effect. In some cases, with the shortest downcomer annulus length, more water was delivered to the lower plenum than predicted by flooding correlations based on data for tubes. (auth)

1670 (CONF-730304-12) MODELING PHILOSOPHY AND SELECTION OF PUMPS FOR USE IN SMALL BLOWDOWN EXPERIMENTS. Olson, D. J. (Aerojet Nuclear Co., Idaho Falls, Idaho). 1972. Contract AT(10-1)-1375. 9p. Dep. NTIS $3.00.

From national topical meeting on water reactor safety; Salt Lake City, Utah, USA (26 Mar 1973).

In order to conduct small-scale experiments which attempt to duplicate the hydraulic phenomena occurring during a loss-of-coolant accident in a pressurized water reactor (PWR) plant, certain scaling philosophies must be employed to design the small system appropriately. Scaling considerations must be applied to all components of the small system and specifically to the primary circulation pump. Operating characteristics of small centrifugal pumps are generally quite different from those of PWR type pumps and the scaling of the small pump may involve various compromises. A method is presented by which the design of a small pump is specified such that the operating characteristics of the pump are expected to approach those of a large pump within the operating zones of primary interest. (auth)

1671 (CONF-730304-13) IMPORTANCE OF THERMAL RADIATION TO STEAM IN ROD BUNDLES. Shaffer, C. J. (Aerojet Nuclear Co., Idaho Falls, Idaho). 1971. Contract AT(10-1)-1375. 9p. Dep. NTIS $3.00.

From national topical meeting on water reactor safety; Salt Lake City, Utah, USA (26 Mar 1973).

Thermal radiation constitutes a major part of the heat transfer prior to fuel rod quenching following a loss-of-coolant accident (LOCA) in a water-cooled reactor. The absorption and emission of thermal radiation by steam contained in the rod bundle are shown to be important to radiation heat transfer analysis. The importance of steam to radiation heat transfer was confirmed through analysis using PWR-FLECHT data and the standard network method of radiation analysis. This analysis demonstrates that the radiation heat transfer calculated including steam is greater than the radiation heat transfer calculated without including steam and may be greater than the experimentally observed heat transfer in PWR-FLECHT. (auth)

1672 (CONF-730304-14) ANALYTICAL DETERMINATION OF HEAT TRANSFER COEFFICIENTS USEFUL IN A LOSS-OF-COOLANT ACCIDENT ANALYSIS. Yuill, W. A.; Mills, J. I. (Aerojet Nuclear Co., Idaho Falls, Idaho). 1972. Contract AT(10-1)-1375. 8p. Dep. NTIS $3.00.

From national topical meeting on water reactor safety; Salt Lake City, Utah, USA (26 Mar 1973).

The results of work being performed to obtain heat transfer correlations to be used in describing the behavior of a two-phase fluid are presented. The correlations being developed are based on analytical models and do not rely on empirical constants. These analytical correlations have the advantage of being extendable over a wide range of experimental variables. The approach applied in the development of these correlations is illustrated through discussion of critical heat flux during forced convection boiling. (auth)

1673 (EUR-4911) SPRAY CC–SPRAY CM–SPRAY EV: SIMPLE RULES FOR THE STUDY OF THE AMOUNTS OF HEAT AND MASS TRANSFERRED BY A WATER-SPRAY SYSTEM AND AN AIR AND WATER–VAPOR ATMOSPHERE. Desogus, C.; Holtbecker, H. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Mar 1973. 78p. (In Italian). Dep. NTIS (U. S. Sales Only) $6.00. EUR FR 100.-.

A preliminary study is presented concerning the calculation of pressure and temperature in a reactor containment after a primary circuit rupture (LOCA). The effects of a water spray system, used in order to reduce the pressure and temperature, are investigated. The codes were applied for water- and organic-cooled reactors. Two types of calculation methods were used: the first is based on heat transfer laws; the second on mass transfer laws. For organic-cooled reactors only the code based on the heat transfer laws was studied. (auth)

1674 (GEAP-13851) LOSS OF FLOW EXPERIMENT IN AN ELECTRICALLY HEATED SODIUM COOLED TEST FACILITY. Pfefferlen, H. C.; Nelson, R. C. (comps.) (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept). Oct 1972. Contract AT(04-3)-189. 65p. Dep. NTIS $5.25.

The dynamic void behavior during transient undercooling in an electrically heated, out-of-pile sodium loop was investigated. The loop contained three heaters (two operational and a third which failed prior to the undercooling transient) surrounded by an insulated fluted liner. Data on coolant flow, pressure, tempera-

ture, and acoustic signals were obtained. Voiding of limited magnitude was detected during the relatively short (~1 sec) period of heater operation following the initial void formation. Low amplitude pressure pulses (<20 psig), sometimes accompanied by acoustic emissions, were detected during the transient. This evidence suggests vapor-bubble collapse as a probable void-limiting mechanism. (auth)

1675 (INIS-mf-278) SEICHES IN JERVIS BAY, N. S. W. THEORY VS. EXPERIMENT. Clarke, D. J. (Wollongong Univ. Coll. (Australia)). Nov 1971. 13p. INIS.

Jervis Bay is the subject of environmental studies because inter alia a proposed nuclear power reactor sited south of Bowen Island is to be cooled by bay water. Six longitudinal free oscillations of periods 33.6, 20.0, 14.2, 10.8, 8.7, and 7.2 min were determined for a one dimensional flow model with approximate solution to the boundary value problem based on the Galerkin method. Since seiches in the bay are of the order of 35 min or less, tidal flow was neglected. Measured power spectral values for the bay on May 15, 1968 had reasonably matched values of 33.75, 20.0, 13.8, 10.1, 8.3, and 6.6, as well as values of 24.0, 17.4, 11.7, 9.0, and 7.3. These non-matched values are attributed to oscillations through the bay entrance. (INIS)

1676 (INIS-mf-283) NUCLEAR POWER AND PUBLIC ACCEPTANCE. Levine, S. (Atomic Energy Commission, Washington, D. C.). 1972. 18p. INIS.

Man's use of energy from fossil fuels has provided him with a way of life unparalleled in the history of the world. It has been known for many years that the supply of these fuels is limited and that new fuel resources have to be developed. There are now additional factors relating to population growth, increased per capita consumption of energy and their associated environmental stresses that reemphasize the need for the development of new energy resources. Continued examination of potential new energy sources confirms the need to proceed with nuclear fission plants and especially the breeder reactor. Growing recognition of the environmental impacts associated with energy use is causing the USA to initiate significant efforts to reduce these effects. It is also raising questions about the ways in which energy is being used and the rate at which energy use should increase. Nuclear power in particular has attracted extensive attention in the last three years because of its very rapid growth. Environmental legislation enacted by the Congress of the USA in recent years includes the National Environmental Policy Act of 1969 and the Water Quality Improvement Act of 1970. Also various court cases have resulted in some judicial interpretations of this legislation that are creating procedural difficulties in bringing power plants into operation. Further Court decisions and perhaps legislative changes may be needed to resolve some of the current difficulties. Opposition to nuclear power has shifted away from low-level releases of radioactivity and thermal effects to questions of reactor safety, the handling of high-level radioactive wastes and the safeguarding of special nuclear materials. The USAEC is continuing its efforts to maintain high levels of quality and safety in the use of nuclear power. (INIS)

1677 (INIS-mf-285) ENVIRONMENT OF NUCLEAR STATIONS IN ENGLAND AND WALES. Williamson, P. (Central Electricity Generating Board, London (England)). 1972. 13p. INIS.

A brief review is given of the reasons for siting nearly all first generation nuclear stations on the coast partly because of the Government's "remote-siting" policy, partly because of the relatively large condenser cooling water requirements of the Magnox stations and partly to reserve the restricted supplies of inland water for coal-fired stations. Partial relaxation of the remote-siting policy in relation to the third and fourth nuclear stations with advanced gas-cooled reactors (AGR) is discussed and their population characteristics are compared with contemporary European stations. The tidal environment of England and Wales is described and recognition is taken of this in the siting and design of coastal nuclear stations to ensure that the warm water discharge does not cause adverse environmental effects. The control and discharge of radioactive substances and the associated environmental monitoring program is discussed. The care taken to avoid encroaching unnecessarily on those parts of the coastline which are prized for amenity and recreational purposes and some steps which can be taken to make power stations as acceptable as possible to the public are discussed. Future British power stations will be predominantly nuclear. Relaxation of the original remote-siting policy has reduced the visual effects on rural landscapes but environmental problems of heated and radioactive discharges remain. Ten years of operational experience with nuclear stations coupled with the demonstrable independence of the regulatory authorities has earned the acceptance of the British public and this possibility explains the absence of the sort of opposition which has recently become endemic elsewhere. (INIS)

1678 (INIS-mf-286) ENVIRONMENTAL CONSIDERATIONS IN THE CONSTRUCTION OF NUCLEAR POWER PLANTS. Wright, J. H. (Westinghouse Electric Corp., Pittsburgh, Pa. Environmental Systems Dept.). 23 Mar 1972. 24p. INIS.

The environmental aspects of siting, constructing and operating nuclear plants have received far more attention than any other actions by man. The effect of ionizing radiation is the most studied, best understood of all environmental contaminants. Research into the safety and environmental effects of nuclear plant operation was begun on a large scale before the first nuclear power plant was built and has been continuing at an accelerated rate ever since. The selection of a nuclear plant location has historically been made on the basis of possible effects which the environment might have on the safety and operability of the plant. Analysis of natural environmental factors such as seismology (earthquakes), hydrology (floods, stable cooling water supply) and climatology (storms, hurricanes, tornadoes etc.) has been routinely conducted as a part of the site selection process. With the increasing worldwide concern for environmental quality, siting considerations are being expanded to include (and minimize) the impact of the plant construction and operation upon the natural environment. While the nuclear plant does not produce classical air pollutants, it does emit small quantities of radioisotopes to air and water and rather large quantities of waste heat. This waste heat, like all waste heat, is eventually dissipated by radiation into outer space but the pathways which this heat takes through the natural environment must be examined to determine and minimize adverse effects on aquatic and terrestrial ecosystems and on microclimatology and air quality. The selection of the plant site and the radiation waste control system can be used to minimize the harmful effects of radiation on both flora and fauna, including man. The analysis of radiation exposure vectors must proceed through direct radiation shine and immersion in air and water to include ingestion from all possible food chain routes. While the typical radiation exposure to the human population from nuclear plants represents less than 1% of the natural background radiation, it is important that plant operators conduct periodic isotopic assays of radioactive emissions and provide a running inventory of releases to the environment in order that proper assessments of radiation risks can be made. The nuclear power plant, as currently designed and built, represents one of man's great achievements in large-scale, complex accomplishments and is all the more significant and unique because adverse environmental effects have been maintained below detectable levels. (INIS)

1679 (JABE-WADCO-1) SEISMIC AND GEOLOGIC SITING EVALUATION FAST FLUX TEST FACILITY, NEAR RICHLAND, WASHINGTON. (Blume (John A.) and Associates, Engineers, San Francisco, Calif.). Aug 1970. 90p. Dep. NTIS $6.50.

For WADCO, Richland, Wash.

The local and regional geologic studies indicate that faulting in the Pasco Basin is probably compatible with Basin and Range type tectonics. Field geologic mapping by the U. S. Geological Survey has shown that the Rattlesnake Hills-Wallula Gap fault should be considered to be an active fault. Data and analysis procedures used in establishing the location and magnitude for the Design Basis Earthquake (DBE) are presented. The DBE has been located 9 miles southwest of the FFTF site on the Rattlesnake-Wallula fault and assigned a magnitude of 6.8. (auth)

1680 (ORNL-TM-4087) ORNL NUCLEAR SAFETY RESEARCH AND DEVELOPMENT PROGRAM BIMONTHLY REPORT FOR NOVEMBER-DECEMBER 1972. Cottrell, W. B.; Bryan, R. H.; Fontana, M. H. (Oak Ridge National Lab., Tenn.). Mar 1973. Contract W-7405-eng-26. 116p. Dep. NTIS $8.00.

The accomplishments during November and December in the research and development program under way at ORNL as part of the U. S. Atomic Energy Commission's Nuclear Safety Program are summarized. Much of this work is in general support of water-cooled power reactor technology, including LOFT and industry programs, and reflects current safety problems, such as blowdown heat transfer studies. Other major projects include experimental investigations of the attachment of nozzles to shells and the implementation of joint AEC-PVRC programs on heavy-section steel technology and nuclear piping, pumps, and valves. Several projects are also conducted in support of the high-temperature gas-cooled reactor (HTGR). Seismic considerations of particular significance in nuclear plant design are evaluated in the seismic program. Several of the above projects are also directly related to another major undertaking, the AEC's standards program, which entails development of engineering safeguards and the establishment of codes and standards for government-owned or -sponsored reactor

facilities. The recent activities of the Nuclear Safety Information Center (NSIC) and the Nuclear Safety journal in behalf of the nuclear community are also discussed. Of particular interest in both of these activities is the emphasis on environmental effects. LMFBR safety studies are reported in a separate document. (auth)

1681 DESIGN AND OPERATION GUIDANCE FOR THE POWER SOURCES SUPPLYING TO SAFETY FACILITIES IN NUCLEAR POWER STATIONS. Tokyo; Japan Electric Association (1972). 3p. (In Japanese).

The guide is applied to power facilities supplying power to safety and protection facilities required at the time of reactor shut-down and during reactor accidents. After defining the terminology used, the following are specified: design—surrounding conditions in which the power sources are operative, capability for inspection, transmission lines, capacity of power receiving facilities, station's own power supply and its independence, capacity, utilization in common for other emergency purposes, connection to loads, protection of the station's own power supply, operation (usage of the station's own power supply), operative readiness of the station's own power supply in normal reactor operation; and inspection, recording, factory inspection pre-commissioning tests, and periodic inspection. (JA)

1682 DESIGN GUIDANCE FOR SAFETY AND PROTECTION SYSTEMS IN NUCLEAR POWER STATIONS. Tokyo; Japan Electric Association (1972). 2p. (In Japanese).

The guide is applied to emergency reactor shut-down systems and the engineered safety systems in nuclear power stations and gives requirements for their performance and reliability. After defining the terminology used, the following are specified: standards for single malfunctions, independence of the safety and protection systems, fail-safe design, system operation under accident conditions, capability for inspection, bypass or removal of the safety and protection systems, pre-set safety and protection values, completeness of the systems, and capability of manual operation. (JA)

1683 EXPERIENCE OF ACTIVITY DISCHARGE AND MONITORING IN THE FOUR GERMAN LIGHT WATER REACTOR POWER STATIONS VAK, KRB, KWL, AND KWO. Boedege, R. (Kernkraftwerk Lingen GmbH, Darme, Ger.); Eickelpasch, N.; Grau, A.; Stephan, W. VGB Kraftwerkstechnik; 52: No. 5, 396-404(1972). (In German).

Measures taken in the four power stations to reduce the emission of activity with the water and through the stack are described. A description of methods of measurement follows a comparison of maximum emissions of activity laid down by the authorities with actual measurements in operation. In addition the treatment of other waste products is described. (GF)

1684 ADVANCED DESIGNS FOR THERMAL POWER STATIONS. Zerna, W. (Univ., Bochum, Ger.). VGB Kraftwerkstechnik; 52: No. 4, 294-300(1972). (In German).

Designs of large natural draught cooling towers and advanced designs required for nuclear power stations, with particular reference to the novel, and unusual stresses caused by pressures from external explosions, plane crashes and earthquakes are discussed. (GF)

1685 NUCLEAR SAFETY. Volume 14, Number 2. Cottrell, W. M.; Jordan, W. H.; Blakely, J. P. (eds.). A Technical Progress Review published for the Technical Information Center, USAEC. Oak Ridge, TN; Oak Ridge National Laboratory (1973). 89p. GPO $0.60.

Significant developments in the field of nuclear safety are covered, limited to topics relevant to the analysis and control of hazards associated with nuclear reactors, operations involving fissionable materials, and the products of nuclear fission and their effects on the environment. Separate abstracts for six of the articles have been prepared. (FS)

For abstracts of individual papers see: 1618, 1686–1688, 1712, and 1760.

1686 LOW-LEVEL ENVIRONMENTAL MONITORING BY FLUCTUATIONS ANALYSIS. Thie, J. A. Nucl. Safety; 14: No. 2, 105-110(1973).

A means is described for separating a reactor plant's variable radiation from a larger and also varying background utilizing the differing character of fluctuations present. It is shown that an accuracy of ±0.9 mR/year in the fence-line dose rate from a boiling-water-reactor (BWR) plume is obtainable from random fluctuation analysis, in which the standard deviation is the basic measurement tool. Other specific applications of autocorrelation, cross-correlation, and spectral analysis to the general problem of signal extraction in low-level environmental monitoring are discussed. (auth)

1687 SAFETY-RELATED OCCURRENCES REPORTED IN OCTOBER AND NOVEMBER 1972. Casto, W. R. (comp.) Nucl. Safety; 14: No. 2, 120-123(1973).

1688 PROGRESS SUMMARY OF NUCLEAR SAFETY RESEARCH AND DEVELOPMENT PROJECTS. Sheldon, M. Nucl. Safety; 14: No. 2, 124-132(1973).

The current status of some of the projects on various aspects of nuclear safety is reported. These projects include research on the integrity of primary systems, environmental and effluent waste studies, general safety studies, fast reactor safety and gas-cooled reactor safety studies. (FS)

1689 ANVISNINGAR ANGAAENDE BRANDFOERSVARET VID KAERNKRAFTVERK. Preliminaera Anvisningar 1972 Utarbetade av Kaernkraftkommitten. (Recommendations for the Fire Protection of Nuclear Power Plants. Preliminary Recommendations 1972 Issued by the Nuclear Power Committee). Stockholm; Svenska Brandfoersvarsfoereningen (1972). 44p.

Recommendations are addressed to projectors, designers, constructors and builders of nuclear power plants and to those responsible for the management of the plant, to authorities and to insurance companies. Principles which should be followed are presented together with more detailed directions for the sectioning of the plant in discrete fire cells, structural parts, escape routes, ventilation, extinguishers, alarms, etc. (SW)

1690 NUCLEAR SAFETY. Volume 14, Number 1. Cottrell, W. B.; Blakely, J. P.; Jordan, W. H. (eds.). A bimonthly technical progress review published for the Technical Information Center, USAEC. Oak Ridge, TN; Oak Ridge National Laboratory (1973). 81p. GPO $0.60.

Significant developments in the field of nuclear safety are covered. Scope is limited to topics relevant to the analysis and control of hazards associated with nuclear reactors, operations involving fissionable materials, and the products of nuclear fission and their effect on the environment. Separate abstracts have been prepared for seven of the articles included. (FS)

For abstracts of individual papers see: 1691–1695, 1761, and 1943.

1691 REGULATIONS OF THE ENVIRONMENTAL EFFECTS OF NUCLEAR POWER PLANTS. Davis, J. P. Nucl. Safety; 14: No. 1, 6-13(1973).

A survey of the regulation of environmental features of nuclear power plants is presented. Receiving particular attention is the jurisdiction of the Atomic Energy Commission under the Atomic Energy Act of 1954, and its expansion under the National Environmental Policy Act of 1969. Several other federal agencies, including the Federal Power Commission, the Corps of Engineers, and the Environmental Protection Agency, also play important roles in this area. In addition, there have been interesting recent developments in the State regulatory picture in the field of power-plant siting. (auth)

1692 PROBABILITY ANALYSIS APPLIED TO LIGHT-WATER REACTORS: LOSS-OF-COOLANT ACCIDENTS. Lindackers, K. H.; Stoebel, W. (Technische Ueberwachungs-Verein Rheinland eV, Cologne). Nucl. Safety; 14: No. 1, 14-20(1973).

It has been the practice in the Federal Republic of Germany to base site selection and engineering safeguards for nuclear power plants on the so-called maximum-credible-accident concept (MCA concept). It will now be necessary to use a more quantitative approach, as developed by the United Kingdom Atomic Energy Authority, because nuclear power plants must be constructed in more densely populated areas. In light-water reactors, loss-of-coolant accidents could lead to a relatively high release of fission products. Probability analysis is applied to loss-of-coolant accidents in the nuclear power plants of Würgassen (BWR) and Stade (PWR), which are now under construction. The influence of uncertainties in the main factors of this analysis (e.g., probability of failures in piping and containment) is discussed. (auth)

1693 SAFETY EXPERIENCE GAINED FROM RAPSODIE OPERATION. Argous, J. P.; (CEN, Cadarache, France); Chantot, H.; Petit, J.; Stachura, S. J. Nucl. Safety; 14: No. 1, 27-36(1973).

Three operational incidents at the French experimental fast reactor Rapsodie are described and analyzed. These events served to identify various design inadequacies to be avoided in future plants and also demonstrated several positive safety aspects of the design. The incidents involved (1) sodium overflow through penetrations in a small rotating plug as a result to inadvertent reactor cover-gas overpressure, (2) a fuel-handling incident that resulted in deformation of handling mechanisms and core assemblies, and (3) overflow of a fusible metal seal in a small rotating

plug due to a pressurization anomaly. The incidents generally involved combinations of design, equipment, procedural, or operational errors. (auth)

1694 SAFETY-RELATED OCCURRENCES REPORTED IN AUGUST AND SEPTEMBER 1972. Casto, W. R. (Comp.). Nucl. Safety; 14: No. 1, 37-40(1973).

All occurrences reported for this period were at power reactors: once again a dry well was pressurized when two safety valves apparently tripped prematurely; an interesting phenomenon occurred when the recirculating-pump speed was increased at a BWR—reactivity decreased; a guide vane broke loose and damaged the cladding in a section of a primary-system water pipe; and two men died in a nonradioactive steam accident. (auth)

1695 PROGRESS SUMMARY OF NUCLEAR SAFETY RESEARCH AND DEVELOPMENT PROJECTS. Sheldon, Myrtleen (Comp. and Ed.). Nucl. Safety; 14: No. 1, 41-47(1973).

The U. S. Atomic Energy Commission's Division of Reactor Development sponsors about 75 projects on aspects of nuclear safety. Information, which may be preliminary, is reported from these projects on the integrity of primary systems; loss of coolant—emergency core cooling; reactor kinetics; containment integrity and siting; and reliability, standards, guides, and codes. (FS)

1696 EVALUATION OF TORSIONAL EFFECTS IN THE SEISMIC ANALYSIS OF SYMMETRIC AND UNSYMMETRIC NUCLEAR POWER PLANT STRUCTURES. Stoykovich, M. (Gibbs and Hill, Inc., New York). Nucl. Eng. Des.; 24: No. 1, 110-124(1973).

The torsional effects of symmetric and unsymmetric structures in the seismic analysis of nuclear power plants are summarized. The idealization of structures to predict the response due to earthquakes is described. The determination of stiffness or flexibility matrices of structures, using an approximate method and finite element technique, is outlined. The evaluation of foundation-structure interaction for structures founded on soft soils, hard rocks, and piles is presented. The analytical methods of analysis such as time-history and spectrum approach are discussed. (auth)

1697 EARTHQUAKE SIMULATION ANALYSIS OF A NUCLEAR POWER PLANT USING COMPUTER OUTPUT MICROFILMING. Uchida, K.; Kasai, Y.; Horikoshi, K. (Muto Inst. of Structural Mechanics, Inc., Tokyo). Kajima Kensetsu Gijutsu Kenkyusho Nempo; 20: 499-508(Jul 1972). (In Japanese).

The vibration characteristics of Fukushima nuclear power plant No. 1 of Tokyo Electric Power Company were analysed using data from vibration tests and seismological observations, and were simulated with HITAC 8500. The simulated results were displayed with a new graphic display system of computer output microfilming. The animation films and the simulation analysis method are described. An ideal vibration model of a reactor and reactor containment structure was prepared by considering reactor building, various machines, and instruments as mass points, and by taking into consideration the rigidity and attenuation of materials connecting the mass points. In order to understand the vibration characteristics of the reactor and reactor containment structure, free vibration with attenuation was analysed, and the natural frequency and damping factor for primary to sixth order vibrating modes were calculated. In the primary vibrating mode, the building and base vibrate in same direction, in secondary mode, the vibration of roof is noticeable, in third mode, the vibration of a reactor pressure vessel is noticeable, and so on. To reproduce the vibration of the Fukushima nuclear plant in the earthquake on May 26, 1970, the forced vibration equation was analysed. This calculation result showed that the primary vibrating mode was predominate in the nuclear plant, i.e., the nuclear plant was so designed as to be rigid structure. (JA)

1698 EFFECTS OF FOUNDATION ROTATION ON SEISMIC INERTIA FORCES OF NUCLEAR POWER PLANT STRUCTURES. Scavuzzo, R. J. (Rensselaer Polytechnic Inst., Hartford, CT); Isenberg, J.; Raftopoulos, D. D. Nucl. Eng. Des.; 24: No. 2, 195-202(1973).

Effects of foundation rotation on seismic inertia forces are studied in two different plane strain finite element investigations. A three-mass model is used to approximate the dynamic characteristics of a containment vessel of a nuclear power plant and its internal structure. In the first study a large finite element mesh is specified in order to eliminate unwanted reflections from the boundary. Motion input to the structure is limited to 2 sec duration. A quiet boundary technique is employed in the second investigation. As a result, earthquake motion inputs of any duration could be specified. Most results are based on portions of two recorded earthquake motions of 4 sec in length. Effects of foundation rotation and lateral soil-structure interaction are evaluated with program output. (auth)

1699 SIMULTANEOUS APPLICATION OF THE VERTICAL AND HORIZONTAL RESPONSE SPECTRA IN THE SEISMIC ANALYSIS. Lin, C. W. (Westinghouse Electric Corp., Pittsburgh). Nucl. Eng. Des.; 24: No. 2, 232-238(1973).

When both vertical and horizontal response spectral loadings are applied simultaneously in the seismic analysis of nuclear power plants, the response is often computed by combining linearly among each mode the effect from both loadings and then take square-root-sum-of-the-squares of all the modes. This practice is not necessarily conservative. Several conservative methods are formulated and discussed. (auth)

1700 VERTICAL SOIL-STRUCTURE INTERACTION OF NUCLEAR POWER PLANTS SUBJECTED TO SEISMIC EXCITATION. Little, R. R. (Univ. of Toledo); Scavuzzo, R. J. Nucl. Eng. Des.; 24: No. 2, 203-213(1973).

The vertical soil-structure interaction problem is investigated by coupling an N-mass lumped mass structure to a two-dimensional elastic half space. This problem is formulated as an integral equation of the Volterra type. Numerical results are obtained by iteration for an idealized threemass two-mode model of a nuclear power plant containment structure. The effects of interaction are evaluated by comparing free-field acceleration spectrum response curves with similar curves determined from foundation motion. (auth)

1701 AEC AND THE LOSS OF COOLANT ACCIDENT. Wilson, R. (Harvard Univ., Cambridge, MA). Nature (London); 241: No. 5388, 317-320(2 Feb 1973).

The background to the concern being expressed about the risks associated with the possible loss of coolant from a nuclear reactor is discussed. (auth)

1702 STUDY ON THE ASEISMIC DESIGN OF MACHINERY, EQUIPMENT, AND PIPING. Shimizu, N. (Tokyo Univ.). Rep. Inst. Ind. Sci., Univ. Tokyo; 22: No. 1, 1-83(Jun 1972). (In Japanese).

Nuclear power stations are required to be extremely safe, and examination is made for aseismic characteristics. Matsushiro and El Centro earthquake wave groups were analyzed, and the method of presuming change in course of time in the frequency characteristics of acceleration wave form was established. Single or a small number of earthquake waves have been used for response analysis, but in view of the statistical property of earthquake response, the analysis with a large number of wave forms is necessary. It was shown that it is reasonable to use the simulating earthquake waves expressing earth movement characteristics at a certain spot for this purpose. Response magnification was determined theoretically and experimentally on the basis of these simulating earthquake waves, and confidence region of the response magnification was shown. (JA)

1703 MISSILE PHENOMENON AND PROTECTION IN NUCLEAR POWER PLANTS WITH LIGHT WATER REACTORS. Genshi Doryoku Kenkyukai Teirei Kenkyukai Nenkai Hokokusho; No. 45, vp. (Aug 1971). (In Japanese).

Problems on the effect of the missile phenomenon in the light water type nuclear power plants are presented. Missiles, considered are piston type such as valve stems, jet-propelled missiles like released liquid from pipes, rotating missiles from turbines, missiles due to strain energy, and vessel rupture. With regard to these missiles, air resistance and effects of the collision and penetration of the missiles were estimated. To protect reactor pressure vessels from these missiles, the following issues are considered: estimation of the possibility of the rupture of reactor pressure vessels, and protection techniques against cracking considered as the main reason for the rupture. These issues are not resolved. In the case of a shockproof design, estimation of the energy of shock waves, establishment of mathematical dynamic models for structural materials, and the dynamics of concrete structures loaded with dynamic stresses need to be studied. When missile-proof design is used, it is necessary to estimate correctly the parameters of reinforced concrete to resist the penetration of missiles. Equations on missile penetration have not yet been established, and reinforced concrete is not enough protection against large mass missiles. (JA)

1704 TREND IN SAFETY CHANNEL INSTRUMENTATION. Genshi Doryoku Kenkyukai Teirei Kenkyukai Nenkai Hokokusho; No. 45, vp. (Aug 1971). (In Japanese).

Safety and protection systems for commercial light water

reactors have been examined. The Oconee, Palisades, and Robert Emmett Ginna power plants were selected for study. The outlines of the instrumentation systems for engineering safety in every plant are described. Almost all safety systems use two redundant subsystems, each being able to perform its function individually. Logic arrangement is usually 2 out of 3 or 2 out of 4. Reactor shut-down systems and examples of safety establishments are illustrated. Performance and reliability of the protection systems are examined and the relation between the protection system and the operation system is described. The interaction of the protection system with the operation system provides significant influence upon the required reliability of both systems. Though complete isolation of both systems is impossible and their independency cannot be maintained, mutual dependency must be avoided. The operator's role in plant protection is also considered. (JA)

1705 METHOD FOR THE REDUCTION OF RELEASED AMOUNT OF RADIOACTIVE MATERIALS FROM FAILED REACTOR CONTAINMENT SYSTEM. Genshi Doryoku Kenkyukai Teirei Kenkyukai Nenkai Hokokusho; No. 45, vp. (Aug 1971). (In Japanese).

A method for the reduction of the amount of radioactive materials released from a reactor containment system at the time of an accident was investigated. Expected causes of damage were collision and penetration of missiles, breakdown due to elevated internal pressure, operational mistakes, defects in design and manufacturing, and disasters such as earthquakes and wars. A large amount of radioactive materials is released from nuclear reactors when the fuel cladding, primary cooling system, emergency core cooling system, or reactor containment system breaks down. The release characteristics, such as radiation dose and leakage amount of radioactive materials must be estimated. Historical data on reactor accidents must be considered. As for the methods of controlling released radiation, the following ones are considered: spray system, bubble injection and pressure reduction to reduce leakage flow, storage of radioactive water, plugging of damaged spot, storage and transportation of radioactive gases, water soaking of the reactor containment system, and the extraction of the radioactive gases. (JA)

Reactor Theory and Calculation

Refer also to abstracts 1555, 1574, and 1645.

1706 (FEI-295) ANALYSIS OF THE INTEGRAL EXPERIMENT ON REACTOR PHYSICS. Van'kov, A. A.; Voropaev, A. I. (Gosudarstvennyi Komitet po Ispol'Zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut). 1972. 14p. (In Russian). INIS.

The concept of "spectral" indices is presented, i.e., integral reactor values, assuming a conversion to group integrals from a normalized spectrum of reaction rates (absorption, fission). Such spectra of reaction rates for basic isotopes in a reactor are of direct interest to designers and evaluators. Methods of measurement of the spectral indices were considered both with and without allowance for importance functions. Practical examples illustrate the concept. (tr-auth)

1707 (GKSS-72-E-15) MULTIGROUP NEUTRON TRANSPORT BURN UP PROGRAM NEUTRA. Krueger, A.; Mueller, A. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht (West Germany)). 1972. 210p. (In German). Dep. NTIS (U. S. Sales Only) $12.50.

NEUTRA is a FORTRAN program in modular form and overlay technique. It solves the multigroup neutron transport equation by means of the S(N) method and calculates the burnup of nuclides using quasianalytical solutions of the burnup equations and assuming piecewise time constant neutron flux. The program was developed especially for the burnup of burnable poisons, for burnup, flux, power and reactivity studies in fuel lattices with burnable poisons, and for burnup, flux and power studies near strongly inhomogeneous locations. NEUTRA was used for the theoretical investigation of the burnup experiments at Geesthacht. An experiment of this series is described as an illustrative example. (INIS)

1708 (INIS-mf-333) STUDY AND USE OF THE $^{6}Li(n,t)^{4}He$ REACTION, NUCLEAR EMULSIONS, AND SEMICONDUCTOR DETECTORS FOR THE DETERMINATION IN FAST ASSEMBLIES OF NEUTRON SPECTRA ABOVE FEW keV. de Leeuw-Gierts, G. (Brussels Univ. (Belgium). Faculte des Sciences). 1970. 128p. (In French). (INIS)

Thesis.

In the determination of neutron spectra in fast zero-power reactors, the ^{6}Li spectrometer, nuclear emulsions, or semiconductor detectors are very promising. The methods described show a large range of application. The interpretation of the E_t and $E_\alpha + E_t$ spectra permit, if the experimental conditions are well designed, the determination of neutron spectra from 5 keV to several MeV. The measurements of the variations of the counting rate along the central axis of the uranium–steel substructure show the utility of the $^{6}Li(n,t)^{4}He$ reaction as a test and complement to the results obtained with integrating detectors. At the present time the lack of data on the differential cross sections for triton emission is the weak point of this technique, but the anisotropy observed in the emission of the particles is, as the measurement shows, a means of studying the spatial distribution of the neutrons. In the case of the measurements of spectra in assemblies less suitable from a nuclear point of view than the assemblies used in these measurements, special electronic setups permit the elimination of the background due to γ radiation and pulse pile-up. (tr-auth)

1709 (JAERI-M-4808) ANDROMEDA, A ONE-DIMENSIONAL DIFFUSION THEORY BURNUP CODE. Ikawa, K. (Japan Atomic Energy Research Inst., Tokyo). May 1972. 64p.

ANDROMEDA is a one-dimensional, multigroup diffusion code for preliminary fast reactor criticality and burnup analyses. The code can be used for calculation of k_{eff} and performance of criticality searches on material compositions and on a reactor dimension at any burnup time step, burnup calculation with an arbitrary time interval, and calculation of kinetics parameters at any burnup time step. The code is linked to three cross section sets, JAERI-FAST, and ABBN, and RCBN sets, each of which is composed mainly of infinitely-dilute cross sections and f-tables for calculation of resonance self-shielding effects. The library tape is prepared by auxiliary code LTANDR. The programming is all in FORTRAN-IV. The code requires a 75k core and three peripheral storage units. (auth)

1710 (JAPFNR-70) EVALUATION AND PRODUCTION OF FAST REACTOR GROUP CONSTANTS (FOR ^{236}U, ^{238}Pu, ^{242}Pu, AND ^{10}B). Ishiguro, Y.; Hasegawa, A.; Takano, H.; Nakagawa, M.; Katsuragi, S. (Japan Atomic Energy Research Inst., Tokyo). May 1972. 50p. (PNC-J-250; JAERI-Memo-4850). Dep. NTIS (U. S. Sales Only).

For Power Reactor and Nuclear Fuel Development Corp., Tokai, Japan.

The fast group constants for ^{236}U, ^{238}Pu and ^{242}Pu, which are needed for analyses of long term burn-up behavior of fast reactors, have been produced. The group structure is the same as that of the JAERI Fast set. Most of nuclear data of ENDF/B-2 were utilized for production. However, the fission cross sections in higher energies and all types of reaction cross sections in resonance energies were evaluated considering various measurements. These evaluated data were adopted for the above cross sections. For ^{10}B, the nuclear data in UKNDL (1970) were adopted considering evaluation results of benchmark tests. The group constants for ^{10}B in the JAERI Fast set were replaced by the new constants. (auth)

1711 HAZARDOUS PROCESSES IN A NUCLEAR REACTOR CONTROLLED BY A REGULATING DEVICE. Dang Van Ba (Ecole Polytechnique, Lausanne, Switzerland). Z. Angew. Math. Phys.; 23: No. 3, 420-433(1972). (In French).

A stochastic model of a reactor with a control rod was studied. By assimilating populations of neutrons, of precursors, and of absorbing atoms associated with control rod displacements to markovian random variables, the Chapman–Kolmogorov equation is established. Using Fokker-Planck and Langevin approximations, one obtains the noise spectral density P(f) of the control rod in terms of reactivity. Applied to a large bandwidth control system, commanded by a low efficient detector, the model permits one to obtain, from an experimental analysis of P(f), the value of $\alpha_c = \beta/l$ where β is the total fraction of delayed neutrons and l, the average lifetime of neutrons. (auth)

1712 COUPLED NEUTRONICS–HYDRODYNAMICS METHODS. Tobias, M. Nucl. Safety; 14: No. 2, 91-94(1973).

The principal features of computer codes and methods for reactor disassembly analysis are briefly surveyed. From the basically hand-calculated method of Bethe and Tait, these methods have progressed to fairly elaborate programs designed to estimate the consequences of a hypothetical fast reactor core disassembly. Successive developments have included such features as Doppler feedback, delayed neutrons, improved equations of state, and more elaborate geometries. (auth)

1713 ENERGY-DEPENDENT NEUTRON TRANSPORT THEORY: CRITICAL DIMENSIONS OF A SLAB. Mai, W. (VEB Kombinat Kraftwerksanlagenbau, Berlin). Kernenergie; 15: No. 9, 306-311(Sep 1972). (In German).

The energy-dependent Boltzmann equation has been reduced to a system of singular integral equations which may easily be solved. Simple expressions for the group fluxes have been derived provided that the solution vector was known. (auth)

1714 MINIMUM TOTAL MASS REACTOR. Bartosek, V.; Zalesky, K. (Nuclear Research Inst., Rez, Czech.). Jad. Energ.; 19: No. 3, 73-76(Mar 1973).

To design a thermal reactor with minimum total mass, the mathematical procedure of Kochurov for determining the minimum critical fuel mass was applied to the Wilkin's procedure for minimum total mass (fuel and moderator). A solution not only for slab geometry but for the three one-dimensional geometries was found. The results agree with the result obtained by Wilkins for an H_2O-^{235}U reactor. (FS)

1715 PROPERTIES AND APPLICATIONS OF THE THERMAL CONDUCTIVITY INTEGRAL. Lartigue G., J. (Univ. Nacional de Mexico, Mexico City). Rev. Mex. Fis., Supl. Fis. Apl.; 21: 25-41(1972). (In Spanish).

Some characteristics of the thermal conductivity integral are indicated. Applications other than in the calculation of thermal reactors with natural uranium dioxide are then discussed. These include calculation of the distribution of temperature in spherical nuclear fuels and limitation of the reactivity exchange in a nuclear reactor. 13 references. (JSR)

1716 DISCRETE MONITORING OF THE IN-CORE POWER DISTRIBUTION IN NUCLEAR REACTORS. Emel'yanov, I. Ya.; Vetyukov, V. N.; Konstantinov, L. V.; Nazaryan, V. G.; Pavlov, I. K.; Postnikov, V. V. At. Energ. (USSR); 34: No. 2, 75-79 (Feb 1973). (In Russian).

In most reactors, in-core detectors discretely located are used to monitor power distribution. Two techniques of detector data handling—an empirical one, based on the application of simple empirical relations, and an experimental method, based on physical calculations—are described. In both cases, random function theory and correlation analysis are used. Resulting errors have been estimated. Data obtained at the Beloyarsk Nuclear Power Station serve to illustrate the application of these two techniques. (auth)

1717 SIMULATION OF THE NEUTRON DIFFUSION EQUATIONS OVER MANY DECADES. Morehouse, N. F.; Carter, J. C.; Bryant, L. T. (Argonne National Lab., IL). Simulation; 20: No. 1, 9-16(Jan 1973).

The simulation of a nuclear reactor system using the neutron diffusion equations coupled to the thermodynamic and mechanical equations is described. In this coupling, representation of the diffusion equation presents considerable difficulty when large power excursions are being simulated. This difficulty arises from the diverse response times (from 10^{-8} to 10^{-1} second) of the coupled equations of the system. A transformation of the diffusion equations is developed which permits the coupling to mechanical and thermodynamic equations of much slower response times, thus eliminating the difficulties previously encountered in simulating these coupled sets of equations. In the transformation, time is the continuous variable and energy and space are made discrete. The reactor core is divided into concentric cylindrical regions and the energy is divided into bands. The transformation involves using natural logarithm of the neutron flux in the center region as a reference and determining the change in the ratio of the natural logarithm of the neutron fluxes in the other regions to that in the center region as a result of a regional variation in neutron production. The transformation permits a simulation to cover many decades of continuous change in neutron flux. It also gives directly the deviation from the steady-state neutron flux distribution. (auth)

1718 SOURCE FLUCTUATION EFFECTS IN RADIATION DIAGNOSIS OF VOIDED FLUIDIC SYSTEMS. Younis, M. H.; Harms, A. A.; Hoffman, T. W. (McMasters Univ., Hamilton, Ont.). Nucl. Eng. Des.; 24: No. 1, 145-151(1973).

The role of the statistical fluctuations of a radiation source on its capability as a diagnostic tool in the determination of voids is examined. Factors such as the influence of the properties of the medium and the probability density distribution of the radiation source are discussed. Experimental investigations of source fluctuation effects have been undertaken and are found to be in excellent agreement with the theoretical predictions. The general framework of analysis is subsequently applied to additional source distribution functions to illustrate the potential void biasing effect of different radiation sources. (auth)

1719 SPACE-ENERGY DISTRIBUTION OF RESONANCE ENERGY NEUTRONS. Dod, A. I. (Inst. of Nuclear Energy, Minsk). Vestsi Akad. Navuk Belarus. SSR, Ser. Fiz. Energ. Navuk; No. 3, 5-11(1972). (In Russian).

The method and algorithm of calculation of the space–energy distribution of resonance energy neutrons are described. The energy distribution is found from the integral slowing down equation, the space distribution is expressed in terms of the first collision probability. Comparison of results of calculations of spectra with an experimental cell of Swedish reactor R1 is given. 13 references. (auth)

1720 NEW METHOD FOR DIGITAL POWER SPECTRUM ANALYSIS. Murata, Y. (Musashi Inst. of Tech., Tokyo); Izumi, S.; Sanda, T. Nucl. Instrum. Methods; 108: No. 2, 243-252(1973).

A new method for calculation of power spectral density by a digital computer is described. The features of the present method are as follows: (1) data samplings are made for individual analyzing frequency and the data are deduced by integrating the ordinally sampled data over the phase interval; (2) the sampled data belonging to the same phases are summed for individual frequency to be analyzed and stored in a specified address of computer memory in succession before multiplying the sampling data by a sinusoidal function. By these procedures, the computing time for power spectral density is reduced. (auth)

1721 SECOND-ORDER BOLTZMANN EQUATION FROM INVARIANT IMBEDDING THEORY. Weiss, Z. (ASEA-ATOM, Vasteras, Sweden). Nucl. Sci. Eng.; 50: No. 3, 294-297(Mar 1973).

The rigorous three-point nodal equations in plane geometry derived in an earlier paper on the basis of invariant imbedding theory have been written in a continuous form by passing to the limit of zero node size. It has been shown that the obtained second-order differential equation is equivalent to the second-order integrodifferential Boltzmann equation or the diffusion equation, depending on the approximation used in the calculation of response functions entering the nodal equations. (auth)

Reactor Components and Accessories

Refer also to abstracts 309, 840, 909, 1828, and 1912.

1722 (RDT-E-6-11-T(3-73)) SIMULATED CORE ASSEMBLIES FOR NUCLEAR REACTORS. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Mar 1973. 14p. RSO.

This standard delineates the requirements for the fabrication, quality assurance, packaging, and delivery of simulated core assemblies including simulated test position assemblies, or individual component parts of such assemblies. (auth)

1723 (RDT-M-3-27-T(1-73)) STAINLESS AND WELDED SMALL DIAMETER AUSTENITIC STAINLESS STEEL TUBING (ASTM A632 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jan 1973. 8p. RSO.

This standard is a revision of the ASTM A632 standard for seamless and welded small diameter austenitic stainless steel tubing with said standard amended to cover nuclear and associated applications of such tubing. (LCL)

1724 INVESTIGATION OF PHOTOELASTIC MEASUREMENT OF ZONE STRESSES IN A CYLINDRICAL CONTAINER UNDER INTERNAL PRESSURE. Guerrini, B.; Vigni, P. (Univ., Pisa, Italy). Ing. Nucl.; 13: No. 1, 23-29(1972). (In Italian).

An experimental study was made of photoelastic studies of stress of a scaled-down model of a cylindrical container made of Araldite B. Isochromatic spectra of longitudinal and transverse sections were taken. The results were compared with "tension indices" reported in ASME Section III. (KSW)

1725 MEASUREMENTS OF NEUTRON CROSS SECTIONS, OF INTEREST FOR REACTORS, WITH THE OAK RIDGE ELECTRON LINEAR ACCELERATOR. Maienschein, F. G. (Oak Ridge National Lab., TN). Energ. Nucl. (Madrid); 16: No. 79, 533-548(1972). (In Spanish).

The electron linear accelerator of Oak Ridge National Laboratory (ORELA) is used to measure neutron cross sections especially in the energy region from 1 keV to 1 MeV by the time-of-flight technique. The double program of the ORELA is the measurement of neutron cross sections to be used in the design of reactors and for basic nuclear physics studies. Only the first is considered. Among the primary needs in the design of reactors is the knowledge of the properties of fission and radiative capture of fissionable material. The accuracy of the cross sections required for the permissible tolerances in the design of power reactors are higher than that actually available.

A continuous experimental program to obtain the exact cross sections is necessary. The use, in the ORELA, of a large scintillation device to measure fission and capture is described and the results obtained are summarized. The problem of flux control is discussed and brief commentaries on the measurement of the fission parameters and of the inelastic neutron collisions are given. The shielding tests of reactors include semi-integral tests of neutron cross sections and comparisons of spectra obtained with neutron spectrometers and time-of-flight spectrometers. (tr-auth)

1726 APPLICATION OF FRACTURE MECHANICS TO NUCLEAR PIPING SYSTEMS. Senchak, W. E.; Widera, O. E. (Sargent and Lundy, Chicago). Eng. Fracture Mech.; 4: No. 4, 877-892(Dec 1972).

With the introduction of Nuclear Energy into the power industry rigid requirements for the design of piping have been set up to prevent accidents that may cause dangers to the health and safety of the public. Of particular concern is the rupture of a pipe. Nuclear piping systems are examined from a fracture mechanics viewpoint considering present day American Society of Mechanical Engineers code standards. Included are calculations of the critical crack length for a typical piping system. A brief discussion of the pipe whip phenomenon is also given. (auth)

1727 RELIABILITY: ESSENTIAL FOR MODERN STEAM GENERATION METHODS. Uebing, D. (Technischer Ueberwachungs Verein Rheinland eV, Cologne); Oude-Hengel, H. H. VGB Kraftwerkstechnik; 52: No. 5, 375-385(1972). (In German).

The construction of large boiler units and the adoption of fully automatic operation set new standards for the design, construction, operation and control of large boiler plants. Safety requirements, availability and life are the factors which determine the quality requirements for structural components, sub-assemblies and systems. (GF)

1728 PRODUCTION OF HYDROGEN AND HELIUM ATOMS IN STRUCTURAL MATERIALS OF REACTORS AND THEIR FRAGILIZATION EFFECT IN THE CLADDING OF FAST REACTORS. Lopez Jiminez, J. (Junta de Energia Nuclear, Madrid). Energ. Nucl. (Madrid); 16: No. 79, 549-562(1972). (In Spanish).

The creation of gases of hydrogen and helium in the structural materials as a result of (n,p) and (n,α) reactions, particularly in the stainless steel cladding of fast reactor fuels, contributes strongly to their deterioration, embrittlement, decrease of the rupture time, etc. A method is given for the calculation of the concentrations of H and He produced during a certain period of irradiation under some conditions of flux and neutron spectra and their relation with the physical properties of the material. Various alloys were studied: stainless steel of the 304 and 316 types, niobium, vanadium–titanium alloys, and Zircaloy under the irradiation conditions of a power thermal reactor and of a fast reactor with a flux of 10^{16} n/cm^2/sec. (tr-auth)

1729 GLANDLESS PUMPS FOR CONVENTIONAL BOILERS AND NUCLEAR REACTORS. Ivanoff, A. Pumps; No. 69, 221-225(Jun 1972).

Since the advent of glandless boiler circulating pumps in the early 1940's, the nuclear reactor and conventional boiler industries have adopted glandless pumps on a large scale. A number of technical problems are however involved in the design of glandless pumps for this application. Among the subjects discussed are: stator winding; bearings; exclusion of air and foreign materials; corrosion and its products, and radioactivity. (auth)

1730 PRISMATIC ELEMENTS FOR THE NEUTRON SHIELD OF A NUCLEAR REACTOR. Patarin, L.; Vivien, J. (to Commissariat a l'Energie Atomique). French Patent 2,116,206. 13 Jul 1972. Filed date 19 Oct 1970. 6p. (In French).

A special neutron shield with easily replaceable elements is presented, these elements being cooled by a high temperature fluid. The elements are in the form of an upright prism (having a hexagonal cross section for example) and are made of graphite. The shield consists of an array of regular parallel canals positioned about the axis of the prism, thus facilitating the passage of the coolant. An absorbent material is distributed in the graphite. This graphite-absorbant mixture has the dual property of moderating neutrons (thus facilitating their capture by the absorbant) and of providing a very refractory structure which is virtually insensitive to high temperatures. The absorbant material can be made of boron or rare earth materials distributed homogeneously in the group. It may be in the form of cylindrical rods having axes parallel to the axis of the prism and composed of boron, rare earth, or graphite materials or constructed of graphite, boron, or an alloyed or nonalloyed steel. This type of shield enables the reactor to be rapidly dismantled using a gripping device to obtain the elements from the reduced number of passage channels. (FR)

1731 RADIAL RESTRAINT MECHANISM FOR REACTOR CORE. Waymire, G. R.; Lubeck, J. F. (to United States Atomic Energy Commission). U. S. Patent 3,708,393. 2 Jan 1973. Filed date 1 Dec 1970. 4p.

A system of laterally supporting fuel assemblies for a fast reactor in a tight-packed array during operation of the reactor includes mechanical linkages operated through concentric operating shafts by motors located at the top of the reactor enclosure to force pressure bars against the sides of the array of fuel and reflector assemblies in the reactor at several vertical locations and at six locations around the reactor. Provision is made within the mechanical linkage to allow for expansion of the reactor core due to thermal transients and to compensate for variations in applied load due to radiation induced creep and stainless steel swelling. (Official Gazette)

1732 IMPROVEMENTS IN OR RELATING TO DRUM DRIVING ARRANGEMENTS. Gurner, J. R.; Pedley, R. M. (to Plessey Co. Ltd.). British Patent 1,298,670. 6 Dec 1972. Filed date 26 Apr 1969. 4p.

Reference is made to driving arrangements for moving flexible elements, such as flexible cables. One application of such a driving arrangement is in the monitoring of a nuclear reactor where it is required to insert a neutron detector into various parts of the core, using a flexible drive electric cable. The improved arrangement described consists of a drum having a circumferential helical groove for element location purposes, with a take-off point at which an element can engage and disengage the groove. The driving arrangement comprises a driven endless belt around the periphery of the drum, in frictional contact therewith over the greater part of the drum circumference and which is arranged to retain a flexible element when positioned in the groove. The surface of the belt not in contact with the drum is toothed, and a toothed drive wheel is provided for engaging the teeth of the belt. The belt driving means may comprise two separately driven toothed drive wheels, to enable the belt to be driven at different speeds. An electromagnetic clutch may be associated with each toothed drive wheel. Pulley arrangements may also be included, together with belt tensioners and guiding means. (UK)

1733 FULL SCALE STRESS INVESTIGATIONS IN REACTOR VESSELS OF ATOMIC ELECTRIC POWER STATIONS. Bortkevich, V. I.; Mikhalev, Yu. K.; Prigorovskii, N. I.; Khurshudov, G. Kh. pp 176-182 of Issled. Temperatur. Napryazheniy. Moscow; Izdatel'stvo Nauka (1972). (In Russian).

Results are presented of tensometric investigations of nuclear reactor vessels of powerful atomic electric power plants. The investigations were carried out during the initial period of operation. They made possible an evaluation of developing stresses and temperatures depending on operating conditions. Characteristics of the state of stress and of the temperature change in the vessel in transient and steady state operating conditions are demonstrated. Recommendations based on results of full scale tensometering are given for the selection of operating conditions. (JPRS)

1734 FUEL CHANNEL CLOSURE PLUG. Janusz, S. A.; Cashen, W. S. (to General Electric Co. Ltd.). Canadian Patent 903,386. 20 Jun 1972.

The method of sealing an end of a fuel channel by the application of a flexible metallic disc against an outlet orifice of the channel, comprising the steps of; applying a predetermined limiting axial load against the disc to effect sealing contact between the disc and a seal face surrounding the outlet orifice; engaging cooperating cam and lug portions between a retaining plug and the end-fitting of the channel located axially outwardly of the disc; and tightening the plug by relative rotation between the cam and the lug portions into axial securing relation against an axially outer end face of the disc, whereby the axial load is substantially transferred to the end-fitting while maintaining the disc in non-rotative relation with the seal face. (CA)

1735 NUCLEAR REACTOR WITH A CORE HAND. Aubert, M. (to Commissariat a l'Energie Atomique). French Patent 2,116,204. 13 Jul 1972. Filed date 15 Oct 1970. 8p. (In French).

A reactor core head is presented which is intended, in particular, for fast reactors with integrated exchangers. The diameters of the rotating plugs are relatively small and the size of the empty space surrounding the core is reduced in spite of the fact that the core head has normal size and form. (FR)

1736 CONTROL OF AIR TIGHTNESS FOR THE MASS SPECTROMETRY OF HELIUM IN NUCLEAR TECHNOLOGY. Diaz

Diaz, J. L.; Jubes, R. E. (Junta de Energie Nuclear, Madrid). Energ. Nucl. (Madrid); 16: No. 79, 523-532(1972). (In Spanish).
The physical and theoretical basics of mass spectrometry and the operational methods which permit localization of leaks are discussed in a general manner. The measurement of the leak rate or of the limits of air tightness for given conditions of pressure difference, temperature, and enclosed fluid are considered. (tr-auth)

1737 VALVE SEPARATING THE LOW PRESSURE LOOPS FROM THE HIGH PRESSURE LOOPS, IN PARTICULAR IN NUCLEAR REACTORS. (to Siemens AG). Belgian Patent 783,153. 8 May 1972. 8p. (In French).
A valve to be used between low-pressure loops and high-pressure loops, especially in nuclear reactors, is described. It is characterized by having a stop valve, operated by a piston, incorporated in the tube for sampling of the complementary cooling and of which the upper face of the control piston is linked by an intermediate pressure tube with the high-pressure side for admission of the sampling tube. The lower face of the piston is connected by the intervention of another pressure tube for opening of the stop valve with the discharge of a complementary cooling pump mounted below the stop valve. (tr-auth)

1738 DEVICE FOR DETERMINING THE NEUTRON FLUX DISTRIBUTION IN A NUCLEAR REACTOR. Klar, E.; Schmid, P.; Schabert, H. P. (to Siemens Aktiengesellschaft). U. S. Patent 3,711,714. 16 Jan 1973. Priority date 14 Jun 1969, Federal Republic of Germany (F. R. Germany). 8p.
The stationary evaluating means is positioned outside the nuclear reactor in operative proximity with the transfer tubes extending into the reactor. The evaluating means measures the activity of stationary columns of balls in the transfer tubes. The stationary evaluating means extends alongside a plurality of transfer tubes and comprises a plurality of radiation detector devices connected in parallel. (Official Gazette)

1739 PRESSURE-RETENTIVE VESSEL, E.G. FOR PRESSURIZED-FLUID NUCLEAR REACTOR. Meyer, J.; Pfeffer, J. (to Fried, Krupp GmbH). U. S. Patent 3,710,857. 16 Jan 1973. Filed date 4 May 1970. 8p.
A pressure-retentive thermally insulated vessel, e.g., for pressurized-fluid nuclear reactors, and a method of making same in which a thin-wall inner shell of corrosion-resistant metal (e.g. stainless steel) is welded from cylinder segments into a hermetically closed container is described. The outer shell of the double-wall lining, whose interwall space is filled with a force-transmitting thermally insulating material (e.g. a low heat-conductivity concrete), is welded together of cylinder segments of heavy-gauge steel. To support the inner wall, a plurality of radial angularly and axially spaced tie rods are welded to the outer surface of the thin inner vessel, passed through openings in the outer wall, and engage in the surrounding body of concrete serving as the outer support and radiation-shielding mass. The openings are sealed by welding and the rods are rigidly fixed to the outer wall, e.g. via bridge plates overlying the openings. (Official Gazette)

Reactor Fuels

Refer also to abstracts 85, 300, 325, 768, 941, 956, 1623, and 1959.

1740 (GKSS-72-E-21) TEST FUEL ELEMENTS CONTAINING SOLID BURNABLE POISON FOR BURNUP INVESTIGATIONS. Ahlf, J.; Greim, L.; Knoth, J.; Kolb, M.; Schwenke, H. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Hamburg (West Germany)). 1972. 20p. (CONF-721138-8). Dep. NTIS (U. S. Sales Only) $3.00.
From symposium on irradiation facilities for research reactors; Teheran, Iran (6 Nov 1972).
Data are evaluated for testing and confirming theoretical models and codes for burnup calculations on reactor cores containing solid burnable poisons for excess reactivity compensation. Test fuel elements consisting of a square array of 3 × 3 rods, the outer eight containing fuel, the inner one containing the poison (boron or cadmium), are irradiated in reflector positions of FRG-2. At intervals of about six months the irradiation is interrupted for burnup measurements. The reactivity worth of the whole test element is measured in a core of fresh MTR elements relative to unirradiated reference inserts by means of calibrated control rods. The burnup of the fuel rods and its axial distribution is measured by γ-scanning. For this purpose a scanning machine with collimator and Ge(Li)-γ-spectrometer is installed in a hot cell. The poison burnup is determined by transmission measurements with monochromatic thermal neutrons on thin discs taken from different axial positions of the poison rods. The experimental set-up for these measurements is connected to a beam tube of FRG-1. Furthermore the poison burnup is measured by neutron radiography. In addition the boron burnup determination is checked by chemical methods. (auth)

1741 (JAERI-M-4881) DESIGN FOR POWER REACTOR FUEL ASSEMBLIES, VOLUME 1 (2nd REVISION). Design Data of Temperature, Heat-flux Distribution, and Mechanical Strength. Morishima, A.; Kuriyama, M.; Harayama, Y.; Shiratori, T.; Izumi, F. (Japan Atomic Energy Research Inst., Tokyo). Jul 1972. 297p. (In Japanese).
The data necessary for reactor fuel design are given on the following: thermal and hydraulic properties, thermal stresses, fission product release rates, $\int kd\theta$ of fuel materials, and fuel/cladding heat transfer coefficients for boiling water type reactors. The materials are helium, water, steam, UO_2, stainless steel, Inconel-X 750, and zirconium alloys. (auth)

1742 FUEL ASSEMBLY FOR FAST REACTOR. Huebotter, P. R. (to United States Atomic Energy Commission). U. S. Patent 3,702,803. 14 Nov 1972. Filed date 12 Feb 1971. 4p.
A fuel assembly for a fast reactor consisting of a bundle of spaced, elongated, stainless-steel-clad fuel pins disposed within a coolant duct, contains means for cooling the coolant duct to a lower temperature than that of the bundle of fuel pins and a crushable spacer material disposed in an annulus between the bundle of fuel pins and the coolant duct so that the coolant duct does not swell even though the fuel pins do swell. The crushable spacer material may be extra strength on the side of the fuel assembly closest to the centerline of the reactor core. (Official Gazette)

1743 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR FUEL ELEMENTS. Milburn, G. (to United Kingdom Atomic Energy Authority). British Patent 1,301,476. 29 Dec 1972. Filed date 3 Sep 1969. 3p.
Spacer grids used in cluster fuel assemblies are described. The spacer grid has a central ferrule and an outer band joined by radial webs dividing the grid into sectors. A number of tubular ferrules are provided within the sectors, joined together at their points of contact with one another and with the central ferrule, the outer band, and the radial webs. Each ferrule has two spaced rigid support members extending radially inwards and lying in the transverse plane of the spacer grid. Springs associated with each ferrule, in opposed relationship to the support members, engage with and bias the fuel pins into engagement with the support members. (UK)

1744 IRRADIATION EXPERIMENTS FOR POWER REACTOR FUEL DEVELOPMENT. Knaab, H.; Stehle, H. (Siemens AG, Erlangen, Ger.). Kerntechnik; 14: No. 12, 566-569(Dec 1972).
The general aspects of irradiation testing in the frame of power reactor fuel research and development work are outlined. For PWR's, the detailed evaluation of the fuel performance and the examination of spent fuel rods and assemblies present the main sources of experience. Moderate steps for further development will be done by introducing "test type" fuel elements and assemblies in existing power reactors. However, there is still a vital need for experiments in research reactors to explore special problems and to perform experiments involving undue risks for the operation requirements of power reactors. Some examples for new experiments in research reactors are described. (auth)

1745 GEOMETRICAL PROPERTIES OF PACKINGS OF EQUAL SPHERES IN CYLINDRICAL VESSELS. Tingate, G. A. (Australian Atomic Energy Commission, Lucas Heights). Nucl. Eng. Des.; 24: No. 2, 153-179(1973).
Experimental and analytical methods are described for establishing some of the mean geometrical properties of unbiased random packings of equal spheres in cylindrical vessels. Experimental determinations have been made of the volumes of the spheres in an outer region of thickness equal to the sphere diameter, and in the remaining central region. Related properties, such as the mean void fractions of the two regions, can be calculated from these. Several preparation methods were used, including some which give rise to packings with axial or radial bias. A model is developed for computing the relevant properties of packings in a semi-infinite vessel with a plane wall. The model is then adapted to unbiased packings in cylindrical vessels, by means of quadratic equations whose coefficients depend on the cylinder-to-sphere diameter ratio. It is shown that commonly used preparation methods, such as placing or pouring spheres on the top surface, can result in packings with radial bias. Two methods of preparing unbiased random packings are described. (auth)

1746 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR FUEL ELEMENTS. Milburn, G.; Chetter, J. (to United Kingdom Atomic Energy Authority). British Patent 1,301,584. 29 Dec 1972. Filed date 8 Apr 1970. 13p.

Spacer grids used in cluster fuel assemblies are described. The spacer grid comprises a grid structure of cellular form, the cells of which are penetrated by the fuel pins. Stop means are provided in the cells, and resilient leaf members extend from the grid structure in each cell to contact the fuel pins. These leaf members have fretting parts overlying the stop means, allowing freedom of lateral vibration of the fuel pins within the cells within limits defined by the stop means. The resilient leaf members may extend longitudinally in the grid structure, the members of each cell being joined with the grid structure at one end. A number of alternative arrangements is described. (UK)

1747 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR FUEL ELEMENTS. Milburn, G. (to United Kingdom Atomic Energy Authority). British Patent 1,295,860. 8 Nov 1972. Filed date 3 Sep 1969. 4p.

Reference is made to fuel assemblies consisting of bundles of fuel pins, with spacer grids restricting fuel pin movement and retaining the correct relative location of the pins in the assembly. Disadvantages of earlier types of spacer grids are described, particularly with regard to fretting of fuel pins. The spacer grid described is of cellular form, with openings through which the fuel pins extend, and at least one pair of support members extending into each opening for supporting the fuel pins laterally in the openings. The support members are longitudinally spaced with respect to the axes of the fuel pins, and resilient means are provided extending into each opening in opposed relationship with the support members and located to engage with and bias the fuel pins into engagement with the support members. The support members are resilient to small lateral deflections of the fuel pins arising from small forces acting on the pins and so as to become substantially rigid to prevent further deflection of the fuel pins under forces greater than a minimum defined by the resilience of the support members. The resilient means may be located so as to engage the fuel pins between the longitudinally spaced support members. (UK)

Reactor Control Systems

Refer also to abstracts 426–428, 430, 494, and 1959.

1748 (GEAP-13824-4) LMFBR ALTERNATE SHUTDOWN SYSTEM, DEVELOPMENT AND TESTING. Fourth Quarterly Report, October–December 1972. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Jan 1973. AT(04-3)-189. 7p. Dep. NTIS $3.00.

The Alternate Shutdown System (ALSS) reference concept for the LMFBR was selected and approved pending further review and improvement of the release latch design. The reference concept is the electromagnet latch drive that utilizes a scram-assist pressure from the core coolant when the control element is released by a latch at its upper end. A backup design will not be retained. (auth)

1749 (JAERI-M-4870) THEORY OF THE NEUTRON FLUX DISTRIBUTION CONTROL SYSTEM DEVELOPED AT THE OECD HALDEN REACTOR PROJECT. Sato, K. (Japan Atomic Energy Research Inst., Tokyo). Jul 1972. 71p. (In Japanese).

The theoretical aspects of the neutron flux distribution control system developed at the OECD Halden Reactor Project are described. In this control system, the core characteristics are represented with the core operator matrix, which is the basis of the parameters in the control system and is determined and adapted to the changes in the core characteristics without previous knowledge on the detailed core characteristics. The theoretical basis of the control system, the derivation of the optimal control law, constraint handling, separation of the slow process such as Xe-feedback, and the problems relating to an unstable core are treated. Some special techniques in the matrix operation used are reviewed. (auth)

1750 (JAERI-M-4914) LOAD FOLLOW CONTROL SYSTEM FOR A NUCLEAR POWER PLANT THROUGH THE EXTENDED LINEARIZATION TECHNIQUE. Sato, K. (Japan Atomic Energy Research Inst., Tokyo). Aug 1972. 40p. (In Japanese).

A load follow control system for a nuclear power plant based on a new concept is proposed. The proposed control system is a linear control system with some artificial state variables named "drift terms." With these drift terms, the control system is less sensitive to the apparent changes in the plant characteristics, and therefore is able to cover a wider range of the plant operation condition. The control system was tested with a BWR plant in a simulation study, showing that it would be very promising for the proposed system to be applied to a real power plant. (auth)

1751 (KURRI-TR-89, pp 123-130) NUCLEAR INSTRUMENTATION FOR THE TSURUGA POWER STATION. Tajiri, Y. (Japan Atomic Power Co., Tokyo). 1971. (In Japanese).

In proceedings of the 3rd study meeting on neutron measurements.

The neutron monitoring system is capable of monitoring the neutron flux in the core from the low intensity (approx. 10^3 n/cm^2/sec) at the fully shutdown condition to that anticipated in the case of overpower conditions requiring reactor shutdown, and informing the operator of the spatial distribution of the neutron flux to assure that the operating limits are not exceeded at any locations within the core. In-core neutron detectors of miniature fission chambers and three basic types of chambers and signal conditioning equipment are used. The Source Range Monitor (SRM) monitors the neutron flux from the fully shutdown condition through criticality to approx. 5×10^8 n/cm^2/sec and uses a pulse counting method with logarithmic count-rate readout. The Intermediate Range Monitor overlaps the SRM from approx. 1×10^8 n/cm^2/sec to the power range of about 15% of the rated power and uses the voltage variance method, so called Campbell method, with one half decade linear readout of nine ranges. The detectors for the SRM and IRM are withdrawable from the high flux region at the normal power operation. The Power Range Monitor (PRM) monitors about 1% to the full power flux and consists of the Local Power Range Monitor (LPRM) monitoring local flux level, the Average Power Range Monitor (APRM) indicating an average core power level and the Rod Block Monitor (RBM) indicating a local average power level around a control rod. (auth)

1752 (KURRI-TR-89, pp 131-135) IN-CORE NUCLEAR INSTRUMENTATION AT MIHAMA UNIT 1 STATION. Hayata, K. (Mitsubishi Atomic Power Industries, Inc., Tokyo). 1971. (In Japanese).

In proceedings of the 3rd study meeting on neutron measurements.

The Mihama Power Station Unit 1 has a movable miniature detector system which measures the flux distribution inside the core. Incore Nuclear Instrumentation is also used for calibration of the Excore Nuclear detector system which protects the core from overpower or overtemperature conditions. Methods on how to correlate Excore NIS to the power distribution and how to calibrate Excore NIS by Incore NIS are given. (auth)

1753 (KURRI-TR-89, pp 136-142) IN-CORE MONITORING SYSTEM AT FUKUSHIMA-1. Seko, T.; Nonomura, S. (Tokyo Electric Power Co. Inc.). 1971. (In Japanese).

In proceedings of the 3rd study meeting on neutron measurements.

A general description of equipment, test experience and equipment calibration for the In-Core Monitoring System at Fukushima-1 is given. (1) A general description of In-Core Monitoring equipment and it's junction. (2) Experience of test and calibration including, difficulty in attaining high insulation required in the signal cables, detailed inspection and functional tests of circuits to comply with system requirement, necessity of test fixtures especially during the MITI test, installation of field changes, resolution of noise problems. (3) Conclusion; the system exhibited greater mechanical problems than electrical. (auth)

1754 (KURRI-TR-89, pp 143-145) IN-CORE NUCLEAR INSTRUMENTATION IN FAST REACTORS. Mochizuki, K.; Yoshida, K.; Matsumoto, K. (Power Reactor and Nuclear Fuel Development Corp., Tokyo). 1971. (In Japanese).

In proceedings of the 3rd study meeting on neutron measurements.

Fast reactor in-core nuclear instrumentation is not developed because of the severe environment of the reactor core, and only experimental devices are used temporarily. Miniature fission chambers and self-powered detectors for high temperature operation under development at PNC are described. (auth)

1755 (KURRI-TR-89, pp 146-149) NUCLEAR INSTRUMENTATION FOR THE ADVANCED THERMAL REACTOR "FUGEN". Suzuki, E. (Power Reactor and Nuclear Fuel Development Corp., Tokyo). 1971. (In Japanese).

In proceedings of the 3rd study meeting on neutron measurements.

The reactor power is measured by the in-core neutron monitoring systems from the neutron source level to the power operation level through about nine decades. In order to obtain sufficient sensitivity to start up the reactor and to have detailed information of the neutron flux throughout the core, all of neutron

detectors are installed in the core. Incore neutron monitoring systems consist of the start-up range monitor, the intermediate range monitor and the power range monitor. The measurable ranges of these monitors partially overlapped each other and fission chambers are used as neutron detectors for these monitors. The important characteristics of the neutron detector for the operation of the ATR are sensitivity change and linearity under the high flux as well as low neutron absorption. Development of Zircaloy sheath cable and chamber is being carried out. (auth)

1756 MODAL APPROACH TO THE OPTIMAL CONTROL SYSTEM SYNTHESIS OF A NUCLEAR REACTOR. Lazarevic, B.; Obradovic, D.; Cuk, N. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). Int. J. Contr.; 16: No. 5, 817-839(Nov 1972).

Identifying modal analysis as the Galerkin (projection) method, general conditions for applying the modal technique to the optimal control system synthesis of a nuclear reactor are provided. It is shown that under some very general restrictions on the performance index, the Galerkin method is applicable to the Hamilton–Jacobi canonical equations whenever they are applicable to the equations describing the mathematical model of a reactor. Using the Keldish theory of operator families, the conditions for completeness of the eigenvectors of the Hamilton–Jacobi operator are established. If these vectors are used as expanding functions in the Galerkin method a rather simple algorithm for computing the optimal control law can be obtained. An iterative variational method for the solution of an eigenvalue problem is provided, which enables on-line implementation of the overall optimization algorithm through a two-level control system. Reactor models for a power control system and a flux distribution control system synthesis are investigated. The methods are illustrated in a simple example of a slab reactor. (auth)

1757 DISTRIBUTED OPTIMAL CONTROL IN A NUCLEAR REACTOR. Chaudhuri, S. P. (Univ. of Evansville, IN). Int. J. Contr.; 16: No. 5, 927-937(Nov 1972).

The linear deterministic mathematical model of a nuclear reactor system, which can be described by parabolic differential equations, and the problems associated with this model are discussed. Also studied is the derivation of a maximum principle for this distributed nuclear reactor system and the problems associated with approximating this distributed system by discretization into a lumped system. Examples concerning the regulator and the servomechanism problems of a nuclear reactor system are presented. (auth)

1758 SOME VERSIONS OF THE POWER CONTROL OF NUCLEAR POWER PLANTS EQUIPPED WITH SODIUM-COOLED FAST REACTORS. Egorov, K. V.; Richter, R. (Inst. of Energy, Moscow). Kernenergie; 15: No. 6, 183-186(Jun 1972). (In German).

Among other things, of essential importance for the industrial application of nuclear power plants equipped with sodium-cooled fast breeders is the development of special power control systems. Several versions of such control systems are described. The steam parameters before the turbine are the main controlled variables, and the reactor exit temperature and neutron flux are the auxiliary controlled variables. Shifting the control rods within the reactor core and the control valve port in by-passes in the second loop serve for the variables to be controlled. The results of analog computer model studies allow the selection of the control system. The steam parameters can be controlled independent of the reactor parameters and short-term fluctuations of load at the generator do not essentially affect the reactor. (auth)

1759 LEVELS OF INTERVENTION OF NUCLEAR INSTRUMENTATION IN MODERN BWR SYSTEMS. Fornaciari, P.; Garagnani, G. (ENEL–CNP, Rome). Ing. Nucl.; 13: No. 1, 22(1972). (In Italian).

The evolution of nuclear instrumentation is traced from early beginnings to modern reactors and boiling water types. The specific power of the reactors has been increased (until practically doubled in Dresden 1) without a compromise in safe practices. Designers have transformed the external detectors (in the vessel) into internal detectors (in the core) for indicating the power level of the reactor. The fundamentals of the "local power range monitor" the "rod block monitor" and the "average power range monitor" are discussed. Fast shutdown because of high neutron flux, rod blocks, and alarm levels are examined. (KSW)

1760 OBSTACLES TO COMPLETE AUTOMATION OF REACTOR CONTROL. Epler, E. P.; Oakes, L. C. Nucl. Safety; 14: No. 2, 95-104(1973).

Anomalous reactivity changes resulting from conditions other than anticipated control-rod motion occurred in early experimental reactors and led to local melting. Doubt has been expressed, however, that such changes could occur in commercial power reactors. Defenses against the reactivity anomaly have since been developed for test and production reactors which have permitted an increased degree of automation to be safely applied. The principles so developed, which rely on digital techniques, are equally applicable to power reactors. Accepted criteria for the application of digital techniques to control and protection systems have not yet been developed; however, an extension of existing practices and precedents should be adequate until such criteria are available. (auth)

1761 HUMAN ENGINEERING FACTORS IN CONTROL-BOARD DESIGN FOR NUCLEAR POWER PLANTS. Raudenbush, M. H. Nucl. Safety; 14: No. 1, 21-26(1973).

Control-board layout design trends in the nuclear power industry are examined and evaluated from a human engineering aspect. Extensive review of existing literature and study of present control-board layout philosophy substantiate the suggestion that a great need exists within the nuclear power industry for control-board layout standards based on formal human engineering studies. Results of a detailed human engineering evaluation of a miniaturized control board are presented to demonstrate both the advantages and disadvantages of size reduction. Finally, a subjective discussion of operator–automation interfaces suggests the direction future control-board design should take to assure optimum operator control and safety. (auth)

1762 SYSTEM IS AUTOMATED FOR IN-SERVICE REACTOR VESSEL INSPECTION. Elec. Light Power (Boston); 51: No. 5, 40-41(Mar 1973).

This automated in-service inspection system enables inspectors to check welds quickly, safely, and thoroughly from the inside of the reactor vessel without going into the radioactive area. The system consists of an immerscope with ultrasonic probes, two digital computers to control the manipulator and the inspection performance, and a television for visual inspection. (FS)

1763 NEUTRON NOISE ANALYSIS OF REACTOR CORES. Lewis, R. H. Power Eng.; 77: No. 2, 40-41(Feb 1973).

On-line neutron noise analysis monitors the reactor core for changes in plant operation. Normal or abnormal conditions that introduce fluctuations in core reactivity are detected by neutron noise analysis. These conditions include such things as vibrations of fuel or control rods, nucleate boiling, and fluctuations in the heat removal system that introduce changes in temperature, flow, or pressure. (FS)

1764 EFFICIENCY OF CONTROL RODS OF COMPLEX SHAPES. Kukhaev, A. I. (Inst. of Nuclear Energy, Minsk). Vestsi Akad. Navuk Belarus. SSR, Ser. Fiz.-Energ. Navuk; No. 3, 12-19(1972). (In Russian).

The method for calculation of the neutron flux and K_{eff} of the reactor having an absorbing element system is described. An element consists of an arbitrary quantity of very thin radial plates and cylindrical rod on the element axis. The results obtained in one-group diffusion approximation calculations are compared with the experimental values for the efficiency of the pair plates, placed symmetrically in a cylindrical core. 9 references. (auth)

1765 CONTROL SYSTEM FOR A NUCLEAR POWER PLANT. (to Westinghouse Electric Corp.). British Patent 1,298,168. 29 Nov 1972. Priority date 19 May 1970, United States of America (USA). 6p.

A process is described for the control of homogeneously dispersed neutron absorbing material in nuclear reactors, and particularly for maintaining an inventory of concentrated and dilute boric acid solutions. The concentrated solution is passed at low temperatures from a first vessel to a second vessel through an ion exchanger having a low content of the material, whereby the material is deposited in the ion exchanger and the concentrated solution is diluted. The dilute solution is then conducted at high temperatures back to the first vessel through a second ion exchanger having a high content of the material, or through the first ion exchanger after its content of the material has been raised by deposition of material, whereby the material stored in the ion exchanger is removed therefrom and carried into the first vessel. The process is repeated as often as necessary to reach any desired concentration of solution in the high concentration storage vessel and dilution in the low concentration tank. The required apparatus is described in detail, including valves and heat exchangers. Liquid may be returned to the reactor from either storage tank. (UK)

1766 INSTRUMENTATION AND CONTROL OF MULTI-PURPOSE NUCLEAR REACTORS. Genshi Doryoku Kenkyukai

Teirei Kenkyukai Nenkai Hokokusho; No. 45, vp. (Aug 1971). (In Japanese).

In the multi-purpose use of nuclear reactors, there are two concepts. One is to use generated steam for power, and another is for different processes in the iron and chemical industries using process heat from reactors. The latter is investigated using high temperature gas reactors (HTGR). The HTGRs enable high burn-up, better neutron economy, and low fuel cycle cost. The thorium-uranium cycle may be used for this type of reactor. Safety is maintained by using negative reactivity. In the HTGR power plants, "reactors slaved to turbines" can be realized. The control system is divided into four parts: neutron instrumentation, helium instrumentation, radioactivity monitors, and plant instrumentation. The helium instrumentation is peculiar to this type of reactor. Problems in the multi-purpose use of reactors are described concerning iron, chemical, and other industries. (JA)

1767 IMPROVEMENTS IN OR RELATING TO THE CONTROL OF NUCLEAR REACTORS. Harrington, E. L. E.; Duncombe, E. (to United Kingdom Atomic Energy Authority). British Patent 1,298,804. 6 Dec 1972. Filed date 30 May 1969. 8p.

A control device is described for charging a unit into the core of a liquid cooled nuclear reactor. It comprises the following: an upper reservoir and a lower receiver for liquid metal neutron absorber, with interconnecting pipe and flow controlling means; a pipe for flow of liquid coolant through the control device, with means for effecting control of the flow control means according to the rate of flow of liquid coolant in the pipe; and means for returning liquid neutron absorber from the receiver to the reservoir. An electromagnetic flow coupler may be employed, and the flow control means may comprise a gas lock and syphon. Means may be provided to shut down the reactor in the event of failure of coolant flow. The neutron absorber may consist of ^{6}Li. (UK)

Nuclear Power Plant Economics

Refer also to abstracts 1590 and 1950.

1768 (INIS-mf-89) INFLUENCE OF NUCLEAR POWER STATIONS ON PRODUCTION COSTS OF ELECTRICITY IN THE ELECTRIC POWER SYSTEM UNDER CZECHOSLOVAK CONDITIONS UP TO 1985. Taller, J.; Puschman, J. 18p. (In Czech). (CONF-701214-6). INIS.

From 5th conference on nuclear power; Piestany, Czechoslovakia (1 Dec 1970).

Three alternatives to the construction of nuclear power stations were considered with respective total capacities of 2300, 5000, and 6200 MW installed in 1985. The total costs of the electric power system over the period of 1977 to 1985 in all the three alternatives range from 109.0 to 110.4 thousand million Czechoslovak crowns. The favorable effect of introducing nuclear power stations on reduced air pollution by flue ash and sulfur oxides is also shown. (INIS)

1769 (INIS-mf-92) POSSIBILITIES OF NUCLEAR HEATING IN CZECHOSLOVAKIA. Stransky, F.; Diouhy, F. 20p. (In Czech.). (CONF-701214-9). INIS.

From 5th conference on nuclear power; Piestany, Czechoslovakia (1 Dec 1970).

Results are given of research on the possible construction of nuclear heat generating plants in Czechoslovakia. The Energoprojekt Institute envisages the use of Voronezh-type pressurized-water reactors of various capacities for nuclear heat generating plants or nuclear power stations with heat output. At present, the cities of Brno and Prague appear to be the most suitable sites for the construction of a nuclear heat source; a detailed examination of the Bratislava, Ziar nad Hronom, and Ostrava localities is recommended. Other construction sites could be at Pardubice, Zaluzi, Olomouc, and Plzen. (INIS)

1770 (INIS-mf-172, pp 79-96) USE OF NUCLEAR SOURCES IN DISTRICT HEATING OF BRNO AND PRAGUE. Stransky, F. (Energoprojekt, Prague).

From nuclear heating symposium; Tatranska Lomnica, Czechoslovakia (13 May 1969).

See CONF-690565-6.

In nuclear heating.

Design studies of nuclear district heating of the cities of Brno and Prague are described. A 500 MW(t) pressurized-water reactor of the Voronezh type with double containment is envisaged to be used both in Prague and in Brno as a source of nuclear heat. The heating station proposed for Brno is to be equipped with one condensing turbogenerator with an output of 53 MW, supplying the distribution system with 355 Gcal/hr at a price of 52 Kcs/Gcal. Under similar conditions, the price of heat produced by a conventional plant would be 76 Kcs/Gcal. In Prague, a combined nuclear and conventional plant is to be used, the nuclear part serving as a base load station. This is to be equipped with two condensing turbo-generators, each with an output of 41 MW, supplying 344 Gcal/hr at a price of less than 100 Kcs/Gcal. The price of heat produced by a conventional plant would be 130 Kcs/Gcal. In addition to economic advantages, other advantages are discussed, such as less air pollution, use of the country's own uranium, and exploitation of Czechoslovak industry. (INIS)

1771 EUROPE AND NUCLEAR ENERGY. Albonetti, A. Paris; Atlantic Institute for International Affairs (1972). 79p. $1.70.

After a brief summary of the energy deficit in Western Europe and the necessity of using nuclear energy for the production of electricity, the nuclear organizations in Britain, France, Federal Republic of Germany, Italy, Spain, Sweden, Belgium, Netherlands, Norway, and Switzerland are described and their energy situations are discussed. The production of natural and enriched uranium, the construction and marketing of reactors, and reprocessing of nuclear fuels are explained. (FS)

1772 STRUCTURE OF NUCLEAR ELECTRICITY PRODUCTION IN THE 70s AND 80s. Mandel, H. (Rheinisch-Westfaelisches Elektrizitaetswerk AG, Essen). Atomwirt., Atomtech.; 18: No. 1, 18-24(Jan 1973). (In German).

With the Federal Republic of Germany as an example, the probable development of electricity consumption and the increasing proportion of nuclear energy for its coverage are demonstrated and explained. The resultant conclusions are then expanded to the USA, the European Community, Great Britain, and France. Light water reactors will initially play the predominant role because of their low construction cost, their advanced state of development, and the great available industrial potential. To completely utilize the advantages of nuclear energy, a closer international cooperation is needed among producers, operators, and licensing agencies. Also needed is an opening of the markets. In this respect, directives must be established for modern reactor types such as SNR and HTR. Free competition in the national and international area must be maintained to insure economic electricity production in the future. (tr-auth)

1773 NEW METHOD FOR THE APPROXIMATE CALCULATION OF THE RELIABILITY AND AVAILABILITY OF REACTOR SYSTEMS. Dressler, E. (Technische Univ., Munich). Kerntechnik; 14: No. 12, 574-581(Dec 1972). (In German and English).

A new method for calculating the reliability and availability of reactor systems is given. After a review of the difficulties encountered with purely analytic and purely simulating methods, a combined method is described based on singling out the most important states of a system and then using this information for calculating the reliability of the system. The method is based on both analytic and simulation techniques. The simulation part consists of finding, from the failure tree of the system and with the use of importance sampling, the so-called smallest failure combinations, also called mode failures. This is followed by the analytic calculation of these combinations by the method of Markoff chains. (auth)

1774 CONCEPTIONAL IDEAS OF THE STRUCTURE OF A MAINTENANCE SYSTEM FOR NUCLEAR POWER PLANTS. Sturm, A.; Ulrich, G. (VEB Kernkraftwerke, Greifswald, Ger.). Kernenergie; 15: No. 6, 177-183(Jun 1972). (In German).

A possible system for nuclear power plant maintenance can roughly be conceived by utilizing the experience gained with existing nuclear power plants. By analyzing failures, maintenance strategies may be derived. Special thought must be given to the start-up phase of the power plant. Presupposition of an effective and aimed maintenance is the systematic failure analysis and weak point study. The broad use of exchange repair requires principles of ordering by site and equipment. The partial maintenance system has to join the total system of electric power generation. (auth)

1775 EFFECTIVE UTILIZATION OF NATURAL URANIUM IN THE CZECH NUCLEAR POWER SYSTEM. Vesely, V.; Pesek, V. Jad. Energ.; 19: No. 3, 77-79(Mar 1973). (In Czech).

It is possible to achieve the model program for Czech nuclear energy by means of combinations of reactor types. One of the economic indicators is the demand for natural uranium. If only water-cooled reactors are built in the year 2000, then toward the end of their lives it would be necessary to spend 100 to 120 billion koruny for uranium. If good converters (breeders) were to be used this expenditure might amount to only 20 to 50 billion koruny, depending on the reactor concept selected. Up to 80% of the natural uranium stocks might be saved. (tr-auth)

1776 NEW GENERATING CAPACITY: WHO'S DOING WHAT. Schuste, R. Power Eng.; 77: No. 4, 40-45(Apr 1973).

Firm plans for 472 steam plants—298 fossil and 174 nuclear—to go on line in the next 15 years indicate an increasing trend in long range planning. The power planning picture for 1973 is compared with that of 1972. The ten utilities leading in committed new generating capacity, the sixteen leading engineering and construction firms, the seven leading boiler and reactor suppliers, and the four leading turbogenerator suppliers are listed with indications of the nuclear and fossil fuel capacities. (FS)

1777 SURVEY OF THE FEDERAL REPUBLIC OF GERMANY. Ehmke, H.; Winnacker, K.; Schmidt-Kuester, W. J.; (and others). Nucl. Eng. Int.; 18: No. 201, 93-123(Feb 1973).

Ten articles on the nuclear industry in the German Federal Republic are included. The fourth German nuclear program describing Government plans for the promotion of research and the application of nuclear energy for 1973-1976 is summarized. An outline is given of the main activities of the nuclear research centers, with reference to their extension into non-nuclear work. The outlook for those industries manufacturing electrical and mechanical components designed for nuclear plants is discussed. An outline of the structure of the fuel cycle industry and of the establishment of multinational companies in the fields of fuel enrichment, reprocessing and transport is followed by a more detailed account of German participation in the uranium enrichment industry and work on the development and manufacture of the gas centrifuge. The present status and future outlook for nuclear stations in the Federal Republic are discussed. Separate articles cover the activities of three main industrial groups whose interests lie respectively in fast breeder reactors, PWR and BWR types, and HTGR type reactors. Finally, current questions of German nuclear law are discussed especially in relation to licensing procedures and third party liability. A folding chart shows the organization of the industry and the relationships between private companies and government organizations. (UK)

1778 AUTOMATION AND LABOR SAVING IN NUCLEAR POWER PLANTS. Genshi Doryoku Kenkyukai Teirei Kenkyukai Nenkai Hokokusho; No. 45, vp. (Aug 1971). (In Japanese).

A preliminary study of how to proceed with research for automation and labor saving in nuclear power plants is described. Work is at the stage of examining present status and trends of automation. Present status and trend of thermal power plants, BWRs, FBRs and ships have been studied. In the thermal power plants, the number of operators is being reduced by standardization of operation and automation. Recently the trend is the automation of turbines and boilers with digital computers. The automation in BWRs seems to correspond to that of the thermal power plants of a few years ago. For the FBRs, Rapsodie reactor and Prototype Fast Reactor have been examined. Automation is adopted in a limited range because the FBRs are still at a developing stage. Ship automation is also being developed. (JA)

1779 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR POWER PLANT. Taylor, P. A.; Chambon, P. (to Babcock and Wilcox Ltd.). British Patent 1,301,092. 29 Dec 1972. Filed date 14 Mar 1969. 4p.

A means of operating a nuclear power plant under conditions other than full load is described. During normal operation coolant flows through all of a number of parallel circuits, but when the total flow required is less than in normal operation no coolant flows through some of the circuits. In the latter case the circuits through which coolant flows are so distributed in the heat exchanger as to ensure that the circuits through which coolant does not flow do not become overheated. Various alternative circuit arrangements are described. (UK)

1780 ATOMIC POWER GENERATION AND HEAT SUPPLY PLANTS FOR INDUSTRIAL COMPLEX. Genshi Doryoku Kenkyukai Teirei Kenkyukai Nenkai Hokokusho; No. 45, vp.(Aug 1971). (In Japanese).

The object of the construction group is to find the best combination and arrangement of power and heat supply plants with industrial complexes. Preliminary investigation was performed by collecting and reviewing data on the characteristics of existing and developing atomic power plants and heat supply media. Industrial complexes are classified into "nuclear powered industrial complexes (Nuplex)" and "nuclear powered agro-industrial complexes." Reactor types of the LWR, AGR, HTGR, FBR and/or MSR may be utilized. Arrangement of the nuclear power and heat supply plants in the complex is discussed. Scale economy of the individual domestic power supplies, collective domestic power supply, and common power plants is compared. Prestressed concrete vessels, PCRV, their advantage, shape, design standards, and research trends are reviewed. (JA)

1781 EVALUATION AND OPTIMIZATION OF INSPECTION AND REPAIR SCHEDULES WITH APPLICATIONS TO NUCLEAR POWER GENERATING STATIONS. Bonhomme, N.M. Pittsburgh; Carnegie-Mellon Univ. (1973). 172p. University Microfilms Order No. 73-4367.

Thesis (Ph. D.).

Stochastic models are developed for evaluating inspection and repair schedules in engineering systems. The approach followed is based upon a combination of finite Markov chain models and Fault Tree evaluation techniques. The use of Markov chain models enables detailed analysis of the deterioration processes and maintenance procedures for individual system components. Fault Tree evaluation techniques are used to express the operational status of the system in terms of the operational performance of its components. The feasibility of the optimization of open-loop maintenance schedules is investigated and is shown to be dependent primarily on the structure of the objective function rather than on problem size. Therefore, application of the optimization technique is possible under certain conditions on system structure, not uncommon in realistic engineering situations. The evaluation and optimization techniques developed are applied to realistic examples in nuclear power engineering practice. (Diss. Abstr. Int., B)

1782 ECONOMIC IMPORTANCE OF NUCLEAR POWER. Baxter, P. Aust. Weld. Res.; 3: No. 1, 8-15(Mar 1972).

1783 NUCLEAR POWER INDUSTRY IN EUROPE. Bonn; Deutsches Atomforum e.V. (1972). 432p. (NP-19702). $10.00.

The status of the nuclear power industry in FORATOM-countries is summarized. Information is included on: electric power generating capacity and nuclear power capacity, both existing and projected to 1980; power reactors operating, under construction, or ordered in FORATOM-countries; fuel cycle; nuclear services; nuclear power plant components; activities of utility companies; European cooperative efforts in developing nuclear power; and national reports from each of 14 FORATOM-countries. (LCL)

Reactor Fuel Cycle Economics

Refer also to abstract 1783.

Reactor Licensing and Regulation

Refer also to abstract 1876.

1784 (DOCKET-50003-165) INDIAN POINT STATION, UNIT 1. Method used to Measure Test Chamber Humidity. (Consolidated Edison Co. of New York, Inc., New York). 13 Apr 1973. 2p. Dep. NTIS $3.00.

1785 (DOCKET-50010-147) DRESDEN NUCLEAR POWER STATION, UNIT 1. Nelia Policy NF-43, Endorsements 87 and 88. (Commonwealth Edison Co., Chicago, Ill.). 9 Apr 1973. 3p. Dep. NTIS $3.00.

Adjustments to 1972 and 1973 liability insurance policy premiums are presented. (DCC)

1786 (DOCKET-50010-148) DRESDEN NUCLEAR POWER STATION, UNIT 1. Failure of 4 Channels on Incore 113. (Commonwealth Edison Co., Morris, Ill. (USA)). 17 Apr 1973. 4p. NTIS $3.00.

1787 (DOCKET-50010-149) DRESDEN NUCLEAR POWER STATION, UNIT 1. Liquid Waste Discharge Calculated to Be 100 Pico Ci/Liter. (Commonwealth Edison Co., Chicago, Ill.). 13 Apr 1973. 2p. Dep. NTIS $3.00.

1788 (DOCKET-50010-150) DRESDEN NUCLEAR POWER STATION, UNIT 1. Malfunction of Valve MO-101 and Emergency Condenser System. (Commonwealth Edison Co., Morris, Ill. (USA)). 16 Apr 1973. 2p. Dep. NTIS $3.00.

1789 (DOCKET-50016-187) ENRICO FERMI ATOMIC POWER PLANT, UNIT 1. Request for Retirement Schedule. (Directorate of Licensing (AEC), Washington, D. C.). 22 Jan 1973. 1p. Dep. NTIS $3.00.

1790 (DOCKET-50016-188) ENRICO FERMI ATOMIC POWER PLANT, UNIT 1. Technical Specifications, Request for Authorization of a Change Dated January 24, 1973. Technical Specifications, Request for Authorization of a Change Dated January 25, 1973. (Power Reactor Development Co., Detroit, Mich.). 26 Jan 1973. 16p. Dep. NTIS $3.00.

Revised specifications are presented concerning subcriticality requirements and deactivation procedures. (DCC)

1791 (DOCKET-50016-189) ENRICO FERMI ATOMIC POWER PLANT, UNIT 1. Disposal of Sodium and Plutonium. (Directorate of Licensing (AEC), Washington, D. C.). 18 Apr 1973. 2p. Dep. NTIS $3.00.

1792 (DOCKET-50016-190) ENRICO FERMI ATOMIC POWER PLANT, UNIT 1. Technical Specifications, Request for Authorization of a Change. (Power Reactor Development Co., Detroit, Mich.). 19 Apr 1973. 8p. Dep. NTIS $3.00.

1793 (DOCKET-50018-23) VALLECITOS BOILING WATER REACTOR. Request for Renewal of DPR-1 to Maintain but Not Operate VBWR for Further Period of Forty Years. (General Electric Co., Pleasanton, Calif. Vallecitos Nuclear Center). 9 Apr 1973. 1p. Dep. NTIS $3.00.

1794 (DOCKET-50146-115) SAXTON NUCLEAR EXPERIMENTAL REACTOR PROJECT. Status of Deactivated Facility for Period September 1, 1972-February 28, 1973. (Saxton Nuclear Experimental Corp., PA). 12 Apr 1973. 29p. Dep. NTIS $3.50.

1795 (DOCKET-50155-147) BIG ROCK POINT NUCLEAR PLANT. Testing of Explosive Actuated Valves. (Consumers Power Co., Jackson, Mich.). 10 Apr 1973. 2p. Dep. NTIS $3.00.

Information is presented concerning revised testing procedures for explosive actuated valves for the liquid poison system. (DCC)

1796 (DOCKET-50155-148) BIG ROCK POINT PLANT. Palisades Plant. Valve Wall Thickness. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 20 Apr 1973. 11p. (Docket-50255-150). Dep. NTIS $3.00.

1797 (DOCKET-50171-118) PEACH BOTTOM ATOMIC POWER STATION, UNIT 1. Technical Specifications, Request for Temporary Change (No. 16). (Philadelphia Electric Co., PA). 19 Apr 1973. 7p. Dep. NTIS $3.00.

A request for deferral of the biennial inspection of the steam generators and testing of the steam relief valves is presented. (JWR)

1798 (DOCKET-50206-195) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Overcurrent Trip Delay Devices. (Southern California Edison Co., Rosemead, Calif.). 25 Apr 1973. 7p. Dep. NTIS $3.00.

1799 (DOCKET-50220-133) NINE MILE POINT NUCLEAR STATION, UNIT 1. Applicant's Environmental Report, Conversion to Full-Term Operating License, Supplement 2. (Niagara Mohawk Power Corp., Syracuse, N. Y.). 13 Apr 1973. 10p. Dep. NTIS $3.00.

1800 (DOCKET-50220-134) NINE MILE POINT NUCLEAR STATION, UNIT 1. Hydrogen Getter. (Niagara Mohawk Power Corp., Syracuse, N. Y.). 19 Apr 1973. 2p. Dep. NTIS $3.00.

1801 (DOCKET-50231-131) SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR. Quarterly Environmental Facility Radiation Survey, December 1, 1972-February 28, 1973. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). 11 Apr 1973. 4p. Dep. NTIS $3.00.

1802 (DOCKET-50231-132) SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR. Request for Authority to Dismantle Facility. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). 17 Apr 1973. 6p. Dep. NTIS $3.00.

1803 (DOCKET-50237-316) DRESDEN NUCLEAR POWER STATION, UNIT 2. Valve Failed to Open During Surveillance Testing. (Commonwealth Edison Co., Chicago, Ill.). 14 Apr 1973. 2p. Dep. NTIS $3.00.

1804 (DOCKET-50237-317) DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3. Special Report No. 19, Revision 1. Quad Cities Station, Units 1 and 2. Special Report No. 6, Revision 1. (Commonwealth Edison Co., Chicago, Ill.). 13 Apr 1973. 6p. (DOCKET-50249-210; DOCKET-50254-185; DOCKET-50265-175). Dep. NTIS $3.00.

Information is presented concerning modifications to the feedwater control system. (DCC)

1805 (DOCKET-50237-318) DRESDEN NUCLEAR POWER STATION, UNIT 2. Motor Operated Valve Failed to Open; Supply Breaker for Isolation Condenser Valve Found Tripped. (Commonwealth Edison Co., Chicago, Ill.). 13 Apr 1973. 3p. Dep. NTIS $3.00.

1806 (DOCKET-50237-319) DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3. Radwaste Waste Surge Tank Found to Contain 1.05 Curies of Radioactivity. (Commonwealth Edison Co., Chicago, Ill.). 13 Apr 1973. 3p. (DOCKET-50249-212). Dep. NTIS $3.00.

1807 (DOCKET-50237-320) DRESDEN NUCLEAR POWER STATION, UNIT 2. Submission of Dresden Special Report No. 22, "Dresden Unit 2 Startup Test Report." (Commonwealth Edison Co., Chicago, Ill.). 17 Apr 1973. 313p. (NEDC-10430-A). Dep. NTIS $17.75.

1808 (DOCKET-50244-151) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Monthly Report of Activity Measurements, March 1-31, 1973. (Rochester Gas and Electric Corp., N. Y.). 17 Apr 1973. 2p. Dep. NTIS $3.00.

1809 (DOCKET-50244-152) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Draft Environmental Statement. (Directorate of Licensing (AEC), Washington, D. C.). Apr 1973. 204p. Dep. NTIS $12.25.

The environmental effects of construction and operation of the Robert E. Ginna Power Reactor Unit 1 are examined. The descriptions include: the environment in the area, including the history, geography, geology, hydrology, climatology, ecology, land and water use including chemical characteristics; the facility and its effluents; the impacts from construction and operation of the facility; alternatives to the proposed action; irreversible and irretrievable long-term commitments of resources from plant operation; need for power; and the benefits-cost analysis of the proposed plant operation. (DCC)

1810 (DOCKET-50245-211) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Inspection Report No. 50-245/73-06. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 23 Mar 1973. 19p. Dep. NTIS $3.00.

1811 (DOCKET-50245-212) MILLSTONE NUCLEAR POWER PLANT, UNIT 1. Secondary Containment Leak Tightness Capability Test. (Millstone Point Co., Hartford, Conn.). 27 Apr 1973. 5p. Dep. NTIS $3.00.

1812 (DOCKET-50247-97) INDIAN POINT NUCLEAR GENERATING UNIT 2. Final Environmental Statement, Comments of U. S. Environmental Agency. (Environmental Protection Agency, Washington, D. C. (USA)). 2 Apr 1973. 6p. Dep. NTIS $3.00.

1813 (DOCKET-50247-99) INDIAN POINT NUCLEAR GENERATING UNIT 2. Facility Operating License DPR 26, Amendment 1. Federal Register Notice of Issuance of Amendment 1. Appendix A, Technical Specifications and Bases. Appendix B, Environmental Technical Specification Requirements. (Directorate of Licensing (AEC), Washington, D.C.). 20 Apr 1973. 254p. Dep. NTIS $14.75.

1814 (DOCKET-50249-211) DRESDEN NUCLEAR POWER STATION, UNIT 3. Main Steam Line Pressure Switch Setting Found to Have Drifted. (Commonwealth Edison Co., Chicago, Ill.). 17 Apr 1973. 3p. Dep. NTIS $3.00.

1815 (DOCKET-50249-213) DRESDEN NUCLEAR POWER STATION, UNIT 3. Loss of Secondary Containment for Six Hours on April 19, 1973. (Commonwealth Edison Co., Morris, Ill. (USA)). 23 Apr 1973. 2p. Dep. NTIS $3.00.

1816 (DOCKET-50250-125) TURKEY POINT PLANT, UNITS 3 AND 4. Semiannual Operating Report 1, October 20, 1972-December 31, 1972. (Florida Power and Light Co.). 26 Mar 1973. 50p. (DOCKET-50251-106). Dep. NTIS $4.50.

1817 (DOCKET-50250-126) TURKEY POINT PLANT, UNITS 3 AND 4. Faulty Overcurrent Trip Delay Device in Circuit Breakers for Engineered Safety Systems. (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 1 May 1973. 5p. (DOCKET-50251-108). Dep. NTIS $3.00.

1818 (DOCKET-50251-107) TURKEY POINT PLANT, UNIT 4. AO 4-73-1, RCC RS4 Damage During Fuel Loading. AO 4-73-2, Drop of Fuel Assembly L24. (Florida Power and Light Co.). 25 Apr 1973. 8p. Dep. NTIS $3.00.

1819 (DOCKET-50254-186) QUAD-CITIES STATION, UNITS 1 AND 2. Licenses DPR-29 and DPR-30, Proposed Change. (Commonwealth Edison Co., Chicago, Ill.). 11 Apr 1973. 6p. (DOCKET-50265-176). Dep. NTIS $3.00.

Revised information is presented concerning in-service inspection requirements. (DCC)

1820 (DOCKET-50254-187) QUAD-CITIES STATION, UNITS 1 AND 2. Excessive Chlorine Residual Concentration in Discharge. (Commonwealth Edison Co., Cordova, Ill.). 14 Apr 1973. 2p. (Docket-50265-177). Dep. NTIS $3.00.

1821 (DOCKET-50254-188) QUAD-CITIES STATION, UNIT 1. Water Conductivity and Off Gas Activity Was Observed. (Commonwealth Edison Co., Cordova, Ill.). 6 Apr 1973. 2p. Dep. NTIS $3.00.

1822 (DOCKET-50255-151) PALISADES PLANT. February Effluent Report. (Consumers Power Co., Jackson, Mich.). 10 Apr 1973. 2p. Dep. NTIS $3.00.

1823 (DOCKET-50255-154) PALISADES PLANT. Control Circuits of all Safety-Related Equipment. (Consumers Power Co., Jackson, Mich.). 30 Apr 1973. 1p. Dep. NTIS $3.00.

1824 (DOCKET-50259-87) BROWNS FERRY NUCLEAR POWER STATION, UNITS 1, 2, AND 3. Problems Associated with Audits of Construction Activities. (Tennessee Valley Authority, Chattanooga). 23 Jan 1973. 28p. (DOCKET-50260-81; DOCKET-50296-77). Dep. NTIS $3.50.

Additional information on quality assurance compliance audit procedures and on control of welder qualifications at the Browns Ferry Nuclear Power Station, Units 1, 2, and 3 is presented. (JWR)

1825 (DOCKET-50259-89) BROWNS FERRY NUCLEAR POWER STATION, UNITS 1, 2, AND 3. Faulty Overcurrent Trip Delay Device in Circuit Breakers for Engineered Safety Systems. (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 1 May 1973. 6p. (DOCKET-50260-83; DOCKET-50296-79). Dep. NTIS $3.00.

1826 (DOCKET-50260-79) BROWNS FERRY NUCLEAR POWER STATION, UNIT 2. Action Taken to Correct Items of Apparent Noncompliance Brought to Attention Following Inspection of December 12-15, 1972. (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 19 Apr 1973. 25p. Dep. NTIS $3.25.

Information on the quality assurance program at the Browns Ferry Nuclear Power Station, Unit 2 is presented. (JWR)

1827 (DOCKET-50260-80) BROWNS FERRY NUCLEAR POWER STATION, UNIT 2. Inspection Report 50-260/73-2. (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 19 Apr 1973. 9p. Dep. NTIS $3.00.

1828 (DOCKET-50261-162) H. B. ROBINSON UNIT 2. Monthly Report of Primary and Secondary Activity Measurements and Effluent Discharge Activity Levels. (Carolina Power and Light Co., Raleigh, NC). 13 Apr 1973. 2p. Dep. NTIS $3.00.

1829 (DOCKET-50261-163) H. B. ROBINSON UNIT 2. Fuel Densification Effects. (Westinghouse Electric Corp., Pittsburgh, PA). Apr 1973. 108p. (WCAP-8115). Dep. NTIS $7.50.

1830 (DOCKET-50261-165) H. B. ROBINSON UNIT 2. Technical Specifications, Change No. 17. (Directorate of Licensing (AEC), Washington, D. C.). 19 Apr 1973. 5p. Dep. NTIS $3.00.

Revised technical specifications are presented concerning the use of test fuel assemblies. (DCC)

1831 (DOCKET-50261-166) H. B. ROBINSON UNIT 2. Spill to Plant Drainage System. (Carolina Power and Light Co., Raleigh, NC). 24 Apr 1973. 2p. Dep. NTIS $3.00.

1832 (DOCKET-50261-167) H. B. ROBINSON UNIT 2. Violation of Plant Administrative Procedures. (Carolina Power and Light Co., Raleigh, NC). 26 Apr 1973. 1p. Dep. NTIS $3.00.

Information is presented concerning the exposure of personnel to radiation which exceeded the specified quarterly limit. (DCC)

1833 (DOCKET-50261-169) H. B. ROBINSON UNIT 2. Boron Injection Capability and Inclusion of All Shutdown Conditions. (Carolina Power and Light Co., Raleigh, N. C.). 1 May 1973. 6p. Dep. NTIS $3.00.

1834 (DOCKET-50263-197) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Standby Gas Treatment System Malfunction and Fuse Rating Discrepancy. (Northern States Power Co., Minneapolis, Minn.). 10 Apr 1973. 3p. Dep. NTIS $3.00.

1835 (DOCKET-50263-198) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Supplemental Information on Rod Drop Accident. (Northern States Power Co., Minneapolis, Minn.). 11 Apr 1973. 22p. Dep. NTIS $3.25.

1836 (DOCKET-50263-199) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Supplementary Information Regarding First Reload. (Northern States Power Co., Minneapolis, Minn.). 13 Apr 1973. 2p. Dep. NTIS $3.00.

1837 (DOCKET-50263-200) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Valve Wall Thickness Verification. (Northern States Power Co., Minneapolis, Minn.). 20 Feb 1973. 3p. Dep. NTIS $3.00.

1838 (DOCKET-50265-178) QUAD-CITIES STATION, UNIT 2. On Test, Local Leak Rate Exceeded Technical Specification Limits. (Commonwealth Edison Co., Cordova, Ill.). 17 Apr 1973. 2p. Dep. NTIS $3.00.

1839 (DOCKET-50265-179) QUAD CITIES STATION, UNIT 2. Switch Out of Calibration. (Commonwealth Edison Co., Cordova, Ill.). 27 Apr 1973. 2p. Dep. NTIS $3.00.

1840 (DOCKET-50266-106) POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2. Valve Wall Thickness. (Wisconsin Electric Power Co., Milwaukee). 3 Feb 1973. 18p. (Docket-50301-92). Dep. NTIS $3.00.

1841 (DOCKET-50267-57) FORT ST. VRAIN NUCLEAR GENERATING STATION. Inspection Report 50-267/73-02. (Directorate of Regulatory Operations (AEC), Denver, Colo. Region IV). 24 Apr 1973. 15p. Dep. NTIS $3.00.

1842 (DOCKET-50267-58) FORT ST. VRAIN NUCLEAR GENERATING STATION. Nonradiological Technical Specifications. (Public Service Co. of Colorado, Denver). Dec 1972. 26p. Dep. NTIS $3.50.

1843 (DOCKET-50267-59) FORT ST. VRAIN NUCLEAR GENERATING STATION. Final Safety Analysis Report, Amendment 26. (Public Service Co. of Colorado, Denver). 16 Apr 1973. 366p. Dep. NTIS $20.50.

Requested and additional information on the Fort St. Vrain Nuclear Generating Station is presented under the following main headings: reactor site; reactor physics; cooling system; buildings and equipment; engineered safeguards; instrumentation; control system; electrical system; auxiliary systems; emergency systems; power conversion system; radioactive waste disposal; operations aspects; personnel; testing; and safety and accident analysis. (JWR)

1844 (DOCKET-50269-98) OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3. Final Safety Analysis Report, Revision 27. (Duke Power Co., Charlotte, N. C.). 13 Apr 1973. 41p. (DOCKET-50270-82; DOCKET-50287-74). Dep. NTIS $4.25.

Revised information is presented concerning the site, fuel assemblies, radioactive waste disposal system, personnel, and technical specifications. (DCC)

1845 (DOCKET-50269-99) OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3. Final Environmental Statement Should Apply to All the Units. (Duke Power Co., Charlotte, N. C.). 17 Apr 1973. 3p. (DOCKET-50270-83; DOCKET-50287-75). Dep. NTIS $3.00.

1846 (DOCKET-50269-102) OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3. Faulty Overcurrent Trip Delay Device in Circuit Breakers for Engineered Safety Systems. (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 1 May 1973. 5p. (DOCKET-50270-84; DOCKET-50287-76). Dep. NTIS $3.00.

1847 (DOCKET-50270-86) OCONEE NUCLEAR STATION, UNIT 2. Inspection Report No. 50-270/73-3. (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 7 May 1973. 19p. Dep. NTIS $3.00.

1848 (DOCKET-50271-169) VERMONT YANKEE NUCLEAR POWER STATION. Technical Specifications, Proposed Change 10. (Vermont Yankee Nuclear Power Corp., Rutland). 9 Apr 1973. 3p. Dep. NTIS $3.00.

Revised technical specifications are presented concerning personnel requirements. (DCC)

1849 (DOCKET-50271-170) VERMONT YANKEE NUCLEAR POWER STATION. Modification of Control Room Air Condition-

ing Damper Control Circuits. (Vermont Yankee Nuclear Power Corp., Rutland). 12 Apr 1973. 1p. Dep. NTIS $3.00.

1850 (DOCKET-50271-171) VERMONT YANKEE NUCLEAR POWER STATION. Offgas Experience and Fuel Inspection and Repair. *(Vermont Yankee Nuclear Power Corp., Rutland). Apr* 1973. 29p. Dep. NTIS $3.50.

1851 *(DOCKET-50271-172) VERMONT YANKEE NUCLEAR* POWER STATION. AO-73-09, Microswitch Failed to Operate. (Vermont Yankee Nuclear Power Corp., Rutland). 13 Apr 1973. *2p. Dep. NTIS $3.00.*

1852 (DOCKET-50271-175) VERMONT YANKEE NUCLEAR POWER STATION. Operations Report No. 73-03 for Month of March 1973. (Vermont Yankee Nuclear Power Corp., Rutland). *26 Apr 1973. 26p. Dep. NTIS $3.50.*

1853 (DOCKET-50272-55) SALEM NUCLEAR GENERAT- *ING STATION, UNIT 1. Environmental Protection Agency* Opinion That State Is Proper Certifying Agency. (Environmental Protection Agency, New York (USA)). 20 Mar 1973. 2p. Dep. *NTIS $3.00.*

1854 (DOCKET-50272-58) SALEM NUCLEAR GENERAT- *ING STATION, UNITS 1 AND 2. Floor Topping Reinforcing,* Auxiliary Building, Diesel Area. (Public Service Electric and Gas Co., Newark, N. J.). 11 Apr 1973. 3p. (DOCKET-50311-58). Dep. NTIS $3.00.

1855 *(DOCKET-50272-59) SALEM NUCLEAR GENERATING* STATION, UNITS 1 AND 2. Change in Fuel Design. (Public Service Electric and Gas Co., Newark, N. J.). 13 Apr 1973. 1p. (DOCKET-50311-59). Dep. NTIS $3.00.

1856 (DOCKET-50272-60) SALEM NUCLEAR GENERAT- ING STATION, UNITS 1 AND 2. Final Safety Analysis Report, Amendment 21. *(Public Service Electric and Gas Co., Newark, N. J.). 12 Apr 1973. 87p. (DOCKET 50311-60).* Dep. NTIS $6.50.

Requested information on the plant design, core design, site, cooling system, containment system, engineered safeguards, operations aspects, and safety analysis for the Salem Nuclear Generating Station, Units 1 and 2 is presented. (JWR)

1857 *(DOCKET-50275-33)* DIABLO CANYON NUCLEAR POWER PLANT, UNITS 1 AND 2. Comments of Department of Interior on Environmental Considerations. (Department of the Interior, Washington, D. C. (USA)). 28 Mar 1973. 9p. (Docket-50323-32). Dep. NTIS $3.00.

1858 (DOCKET-50275-40) DIABLO CANYON NUCLEAR POWER PLANT, UNITS 1 AND 2. Request for Recision of Order Suspending Certain Construction Activities. (Pacific Gas and Electric Co., San Francisco, Calif.). 19 Apr 1973. 26p. *(DOCKET-50323-37).* Dep. NTIS $3.50.

1859 (DOCKET-50275-41) DIABLO CANYON NUCLEAR POWER PLANT, UNIT 1. Inquiry Report No. 050-0275/73-01Q. (Directorate of Regulatory Operations (AEC), Berkeley, Calif. (USA). Region V). 19 Apr 1973. 2p. Dep. NTIS $3.00.

Information is presented concerning the splitting of plastic insulation on electrical equipment. (DCC)

1860 (DOCKET-50277-84) PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3. Main Steam Line Restraints. (Philadelphia Electric Co., PA). 11 Apr 1973. 5p. (DOCKET-50278-79). Dep. NTIS $3.00.

1861 (DOCKET-50277-85) PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3. Final Safety Analysis Report Amendment 25. (Philadelphia Electric Co., PA). 19 Apr 1973. 66p. (Docket-50278-80). Dep. NTIS $5.50.

1862 (DOCKET-50277-86) PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3. Final Safety Analysis Report, Supplement No. 2. (Philadelphia Electric Co., PA). 1973. 93p. (DOCKET-50278-81). Dep. NTIS $6.75.

Information is presented concerning the failure of piping systems outside the primary containment system. (DCC)

1863 (DOCKET-50280-122) SURRY POWER STATION, UNITS 1 AND 2. Technical Specifications, Change 6. (Directorate of Licensing (AEC), Washington, D. C.). 30 Mar 1973. 45p. (DOCKET-50281-98). Dep. NTIS $4.25.

Revised technical specifications are presented concerning fuel assembly safety limits and control rod insertion limits. (DCC)

1864 (DOCKET-50280-123) SURRY POWER STATION, UNIT 1. AO-S1-73-04, Failure of Main Steam Line Trip Valve. *(Virginia Electric and Power Co., Richmond). 10 Apr 1973.* 7p. Dep. NTIS $3.00.

1865 *(DOCKET-50280-125) SURRY POWER STATION,* UNITS 1 AND 2. Fuel Densification. (Westinghouse Electric Corp., Pittsburgh, PA). Apr 1973. 27p. (Docket-50281-101; *WCAP-8013(Add.1)). Dep. NTIS $3.50.*

1866 (DOCKET-50281-100) SURRY POWER STATION, *UNIT 2. Inspection Report 50-281/73-3.* (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 17 Apr 1973. 25p. Dep. NTIS $3.25.

1867 (DOCKET-50282-99) PRAIRIE ISLAND NUCLEAR *GENERATING PLANT, UNITS 1 AND 2. Environmental State-* ment, Comments of Advisory Council on Historic Preservation. (Advisory Council on Historic Preservation, Washington, D.C. *(USA)). 21 Mar 1973.* 6p. (Docket-50306-94). Dep. NTIS $3.00.

1868 *(DOCKET-50282-102)* PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT 1. Inspection Report 050-282/73-03. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 6 Mar 1973. 9p. Dep. NTIS $3.00.

1869 *(DOCKET-50282-104) PRAIRIE ISLAND NUCLEAR* GENERATING PLANT, UNITS 1 AND 2. Steps Taken to Correct Items of Noncompliance Brought to Attention Following Inspection of January 31-February 1, 1973. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 13 Apr 1973. 34p. *(DOCKET-50306-98). Dep. NTIS $3.75.*

Information on quality assurance procedures for steam line check valves and ultrasonic testing equipment at the Prairie Island *Nuclear Generating Plant, Units 1 and 2* is presented. (JWR)

1870 (DOCKET-50282-105) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Fuel Densification. *(Westinghouse Electric Corp., Pittsburgh, PA). Mar 1973.* 76p. (DOCKET-50306-99; WCAP-8091). Dep. NTIS $6.00.

1871 *(DOCKET-50282-106)* PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT 1. Applicant's Response to Comments on the Draft Environmental Statement. (Northern States Power Co., Minneapolis, Minn.). 19 Apr 1973. 15p. (DOCKET-50306-100). Dep. NTIS $3.00.

1872 (DOCKET-50282-109) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Draft Environmental *Statement, Errata Changes in Response to Comments.* (Northern States Power Co., Minneapolis, Minn.). 27 Apr 1973. 2p. (DOCKET-50306-102). Dep. NTIS $3.00.

1873 (DOCKET-50285-89) FORT CALHOUN STATION, UNIT 1. Review of Control Circuits of All Safety Related Equipment. (Omaha Public Power District, Nebr.). 13 Apr 1973. 1p. Dep. NTIS $3.00.

1874 (DOCKET-50285-90) FORT CALHOUN STATION, UNIT 1. Failure of Circuit Breakers in Engineered Safety Systems. (Omaha Public Power District, Nebr.). 3 Apr 1973. 6p. Dep. NTIS $3.00.

1875 *(DOCKET-50286-76) INDIAN POINT NUCLEAR* GENERATING UNIT 3. Applicant's Environmental Report, Supplement 7. (Consolidated Edison Co. of New York, Inc., New York). 18 Apr 1973. 50p. Dep. NTIS $4.50.

1876 (DOCKET-50289-94) THREE MILE ISLAND NUCLEAR STATION, UNIT 1. Final Safety Analysis Report, Amendment 38. (Metropolitan Edison Co., Reading, PA). 13 Apr 1973. 37p. Dep. NTIS $4.00.

Requested information on the analysis of consequences of postulated pipe failures outside the containment structure for the Three Mile Island Nuclear Station, Unit 1 is presented. (JWR)

1877 (DOCKET-50293-130) PILGRIM NUCLEAR POWER STATION. Ultrasonic Resin Cleaner Performance Report. (Boston Edison Co., Mass.). 10 Apr 1973. 3p. Dep. NTIS $3.00.

1878 (DOCKET-50293-131) PILGRIM NUCLEAR POWER STATION. AO-73-12, Differential Pressure Switch Out of Calibration. (Boston Edison Co., Mass.). 14 Apr 1973. 2p. Dep. NTIS $3.00.

1879 (DOCKET-50293-134) PILGRIM NUCLEAR POWER STATION. AO-73-13, Main Steam Line High Flow Sensor Out of

Calibration. (Boston Edison Co., Mass). 25 Apr 1973. 1p. Dep. NTIS $3.00.

1880 (DOCKET-50295-98) ZION STATION NUCLEAR POWER PLANT, UNITS 1 AND 2. Inspection Reports 050-295/73-10 AND 050-304/73-04. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 5 Apr 1973. 29p. (DOCKET-50304-88). Dep. NTIS $3.50.

1881 (DOCKET-50295-99) ZION STATION NUCLEAR POWER PLANT, UNITS 1 AND 2. Inspection Reports 050-295/73-08 and 050-304/73-03. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 6 Apr 1973. 10p. (DOCKET-50304-89). Dep. NTIS $3.00.

1882 (DOCKET-50295-103) ZION STATION NUCLEAR POWER PLANT, UNITS 1 AND 2. Mutual Atomic Energy Liability Underwriters Policy No. MF-64. (Commonwealth Edison Co., Chicago, Ill). 24 Apr 1973. 20p. (DOCKET 50304-90). Dep. NTIS $3.00.

1883 (DOCKET-50298-70) COOPER NUCLEAR STATION. Environmental Impact Statement, Comments of Nebraska Game and Parks Commission. (Nebraska Game and Parks Commission, Lincoln (USA)). 20 Mar 1973. 9p. Dep. NTIS $3.00.

1884 (DOCKET-50298-74) COOPER NUCLEAR STATION. Final Environmental Statement, Objections of United States Department of the Interior. (Department of the Interior, Washington, D. C. (USA)). 16 Apr 1973. 2p. Dep. NTIS $3.00.

1885 (DOCKET-50305-76) KEWAUNEE NUCLEAR POWER PLANT. Final Safety Analysis Report, Amendment 28. (Wisconsin Public Service Corp., Green Bay). 13 Apr 1973. 308p. Dep. NTIS $17.50.

Revised and requested information on design criteria to mitigate consequences of postulated pipe ruptures outside of containment and on containment and subcompartment pressures for the Kewaunee Nuclear Power Plant is presented. (JWR)

1886 (DOCKET-50305-77) KEWAUNEE NUCLEAR POWER PLANT. Steps Taken to Correct Items of Noncompliance Brought to Attention Following Inspections of January 18-19, February 2, and February 5, 1973. (Wisconsin Public Service Corp., Green Bay). 29 Mar 1973. 25p. Dep. NTIS $3.25.

Information on changes in the pre-operational testing program at the Kewaunee Nuclear Power Plant is presented. (JWR)

1887 (DOCKET-50309-105) MAINE YANKEE ATOMIC POWER STATION. Fuel Densification and Its Effects. (Directorate of Licensing (AEC), Washington, D.C.). 15 Mar 1973. 79p. Dep. NTIS $6.00.

1888 (DOCKET-50309-106) MAIN YANKEE ATOMIC POWER STATION. Regulatory Operations Bulletin No. 73-1, Faulty Overcurrent Trip Delay Device in Circuit Breakers for Engineered Safety Systems. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 23 Feb 1973. 6p. Dep. NTIS $3.00.

1889 (DOCKET-50309-108) MAINE YANKEE ATOMIC POWER STATION. Faulty Overcurrent Trip Delay Devices in Circuit Breakers for Engineered Safety Systems. (Maine Yankee Atomic Power Co., Westboro, Mass). 21 Mar 1973. 1p. Dep. NTIS $3.00.

1890 (DOCKET-50312-70) RANCHO SECO NUCLEAR GENERATING STATION, UNIT 1. Steps Taken to Correct Items Brought to Attention Following Inspection December 18-21, 1972. (Directorate of Regulatory Operations (AEC), Berkeley, Calif. (USA). Region V). 16 Apr 1973. 20p. Dep. NTIS $3.00.

Information is presented concerning quality assurance requirements during construction. (DCC)

1891 (DOCKET-50313-73) ARKANSAS NUCLEAR ONE, UNIT 1. Fuel Densification Interim Report. (Arkansas Power and Light Co., Little Rock). 13 Apr 1973. 9p. Dep. NTIS $3.00.

1892 (DOCKET-50315-99) DONALD C. COOK NUCLEAR PLANT, UNITS 1 AND 2. Draft Environmental Statement, Comments of Michigan Department of Natural Resources. (Michigan Dept. of Natural Resources, Lansing (USA)). 21 Mar 1973. 19p. (DOCKET-50316-99). Dep. NTIS $3.00.

1893 (DOCKET-50315-101) DONALD C. COOK NUCLEAR PLANT, UNITS 1 AND 2. Environmental Report, Comments of Department of Natural Resources, State of Michigan. (Michigan Dept. of Natural Resources, Lansing (USA)). 30 Mar 1973. 1p. (Docket-50316-101). Dep. NTIS $3.00.

1894 (DOCKET-50315-111) DONALD C. COOK NUCLEAR POWER PLANT, UNITS 1 AND 2. Draft Environmental Statement, Response to Comments from Michigan Department of Natural Resources. (Indiana and Michigan Power Co., New York). 17 Apr 1973. 7p. (DOCKET-50316-110). Dep. NTIS $3.00.

1895 (DOCKET-50315-112) DONALD C. COOK NUCLEAR PLANT, UNITS 1 AND 2. Benton Harbor Power Plant Limnological Studies. Part XII. Studies of Fish Population Near the Donald C. Cook Nuclear Power Plant, 1972, Addendum. (Indiana and Michigan Power Co., New York). 11 Apr 1973. 14p. (DOCKET-50316-111). Dep. NTIS $3.00.

1896 (DOCKET-50315-113) DONALD C. COOK NUCLEAR PLANT, UNITS 1 AND 2. Final Safety Analysis Report, Amendment 41. (Indiana and Michigan Power Co., New York). 16 Apr 1973. 15p. (DOCKET-50316-112). Dep. NTIS $3.00.

Revised and requested information on buildings and structures, cooling system components, personnel, and test procedures at the Donald C. Cook Nuclear Plant, Units 1 and 2 is presented. (JWR)

1897 (DOCKET-50315-114) DONALD C. COOK NUCLEAR PLANT, UNITS 1 AND 2. Draft Environmental Statement, Comments of United States Department of the Interior. (Department of the Interior, Washington, D. C. (USA)). 16 Apr 1973. 13p. (DOCKET-50316-113). Dep. NTIS $3.00.

1898 (DOCKET-50317-91) CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. Final Safety Analysis Report, Amendment 35. (Baltimore Gas and Electric Co., MD). 13 Apr 1973. 90p. (DOCKET-50318-88). Dep. NTIS $6.50.

Revised information on the containment system, buildings and equipment, electrical system, operations aspects, personnel, emergency planning, and safety analysis for the Calvert Cliffs Nuclear Power Plant, Units 1 and 2 is presented. (JWR)

1899 (DOCKET-50317-92) CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. Review of Control Circuits for Safety Related Equipments. (Baltimore Gas and Electric Co., MD). 19 Apr 1973. 1p. (Docket-50318-89). Dep. NTIS $3.00.

1900 (DOCKET-50321-76) EDWIN I. HATCH NUCLEAR PLANT, UNIT 1. Inspection Report 50-321/73-3. (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 27 Apr 1973. 9p. Dep. NTIS $3.00.

1901 (DOCKET-50322-34) SHOREHAM NUCLEAR POWER STATION, UNIT 1. Provisional Construction Permit CPPR-95. (Directorate of Licensing (AEC), Washington, D.C.). 14 Apr 1973. 6p. Dep. NTIS $3.00.

1902 (DOCKET-50324-76) BRUNSWICK STEAM ELECTRIC PLANT, UNITS 1 AND 2. Final Safety Analysis Report, Amendment 17. (Carolina Power and Light Co., Raleigh, N. C.). 19 Apr 1973. 177p. (DOCKET-50325-77). Dep. NTIS $11.00.

Revised information on the cooling system, buildings and equipment, auxiliary systems, and safety analysis for the Brunswick Steam Electric Plant, Units 1 and 2 is presented. (JWR)

1903 (DOCKET-50327-37) SEQUOYAH NUCLEAR PLANT, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 13. (Tennessee Valley Authority, Chattanooga). 11 Apr 1973. 10p. (DOCKET-50328-35). Dep. NTIS $3.00.

Revised and additional information is presented concerning containment structure penetrations. (DCC)

1904 (DOCKET-50331-91) DUANE ARNOLD ENERGY CENTER. Final Environmental Statement, Comments of United States Department of the Interior Not Adequately Addressed. (Department of the Interior, Washington, D.C. (USA)). 16 Apr 1973. 3p. Dep. NTIS $3.00.

1905 (DOCKET-50331-92) DUANE ARNOLD ENERGY CENTER. Steps Taken to Correct Items of Noncompliance Brought to Attention Following Inspection on December 7-8, 1972. (Iowa Electric Light and Power Co., Cedar Rapids). 29 Jan 1973. 19p. Dep. NTIS $3.00.

Additional information on the procedures for welding and bending of pipes at the Duane Arnold Energy Center is presented. (JWR)

1906 (DOCKET-50331-93) DUANE ARNOLD ENERGY CENTER. Environmental Monitoring Program, October 1-December 31, 1972. (Iowa Electric Light and Power Co., Cedar Rapids). 6 Apr 1973. 38p. Dep. NTIS $4.00.

1907 (DOCKET-50331-94) DUANE ARNOLD ENERGY CENTER. Staff Safety Evaluation, Response to Statements. (Iowa Electric Light and Power Co., Cedar Rapids). 16 Apr 1973. 3p. Dep. NTIS $3.00.

1908 (DOCKET-50333-88) JAMES A. FITZPATRICK NUCLEAR POWER PLANT. Main Steam Leakage Collection System. (Power Authority of the State of New York). 12 Apr 1973. 5p. Dep. NTIS $3.00.

1909 (DOCKET-50334-59) BEAVER VALLEY POWER STATION, UNIT 1. Comments on Draft Environmental Statement. 10 Apr 1973. 1p. Dep. NTIS $3.00.

1910 (DOCKET-50335-55) ST. LUCIE PLANT, UNIT 1. Inspection Report 50-335/73-1. (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 18 Apr 1973. 21p. Dep. NTIS $3.25.

1911 (DOCKET-50339-58) NORTH ANNA POWER STATION, Unit 2. Inquiry Report 50-339/73-1Q. (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 19 Apr 1973. 13p. Dep. NTIS $3.00.

Information is presented concerning the transporting of steam generators to the reactor site. (DCC)

1912 (DOCKET-50344-55) TROJAN NUCLEAR PLANT. Geophysical Survey. (Portland General Electric Co., Oreg.). [nd]. 9p. Dep. NTIS $3.00.

1913 (DOCKET-50344-56) TROJAN NUCLEAR PLANT. Results of Laboratory Rock Testing. (Portland General Electric Co., Oreg.). [nd]. 22p. Dep. NTIS $3.25.

1914 (DOCKET-50344-57) TROJAN NUCLEAR PLANT. Safety Related Schematic Diagrams. Volume 1. (Portland General Electric Co., Oreg). Apr 1973. 286p. Dep. NTIS $16.50.

1915 (DOCKET-50344-58) TROJAN NUCLEAR PLANT. Safety Related Schematic Diagrams. Volume 2. (Portland General Electric Co., OR). Apr 1973. 290p. Dep. NTIS $16.50.

1916 (DOCKET-50344-59) TROJAN NUCLEAR PLANT. Final Safety Analysis Report, Amendment No. 2. (Portland General Electric Co., OR). Apr 1973. 290p. Dep. NTIS $3.00.

Revised and requested data are presented concerning site geology, and listing of instrumentation and piping system diagrams. (DCC)

1917 (DOCKET-50344-60) TROJAN NUCLEAR PLANT. Draft Environmental Statement, Comment of United States Department of the Interior. (Department of the Interior, Washington, D. C. (USA)). 13 Apr 1973. 4p. Dep. NTIS $3.00.

1918 (DOCKET-50346-57) DAVIS-BESSE NUCLEAR POWER STATION. Notice of Receipt of Application for Facility Operating License; Notice of Consideration of Issuance of Facility License, and Notice of Opportunity for Hearing. (Directorate of Licensing (AEC), Washington, D. C.). 19 Apr 1973. 9p. Dep. NTIS $3.00.

1919 (DOCKET-50348-56) JOSEPH M. FARLEY NUCLEAR PLANT, UNIT 1. Inquiry Report 50-348/73-2Q/CDR. (Directorate of Licensing (AEC), Washington, D. C.). 18 Apr 1973. 4p. Dep. NTIS $3.00.

Information is presented concerning a fire in the protective covering on reactor upper internals in the storage yard. (DCC)

1920 (DOCKET-50352-34) LIMERICK GENERATING STATION, UNITS 1 AND 2. Conditional Water Use Approval by Delaware River Basin Commission. (Delaware River Basin Commission, Trenton, N. J. (USA)). 2 Apr 1973. 16p. (DOCKET-50353-34). Dep. NTIS $3.00.

1921 (DOCKET-50354-36) NEWBOLD ISLAND NUCLEAR GENERATING STATION, UNITS 1 AND 2. Conditional Water Use Approved by Delaware River Basin Commission. (Delaware River Basin Commission, Trenton, N. J. (USA)). 2 Apr 1973. 16p. (Docket-50355-35). Dep. NTIS $3.00.

1922 (DOCKET-50361-38) SAN ONOFRE NUCLEAR GENERATING STATION, UNITS 2 AND 3. Draft Environmental Statement, Additional Agency Comments. (Southern California Edison Co., Rosemead, Calif.). 16 Apr 1973. 100p. (DOCKET-50362-37). Dep. NTIS $7.00.

1923 (DOCKET-50361-39) SAN ONOFRE NUCLEAR GENERATING STATION, UNITS 2 AND 3. Preliminary Safety Aanlysis Report, Amendment 17. (Southern California Edison Co., Rosemead, Calif.). 18 Apr 1973. 339p. (DOCKET-50362-38). Dep. NTIS $19.00.

Additional information on tsunami and slope stability studies at the site for the San Onofre Nuclear Generating Station, Units 2 and 3 is presented. (JWR)

1924 (DOCKET-50363-49) FORKED RIVER NUCLEAR GENERATING STATION, UNIT 1. Final Environmental Statement, Comments of United States Environmental Protection Agency. (Environmental Protection Agency, New York (USA)). 4 Apr 1973. 1p. Dep. NTIS $3.00.

1925 (DOCKET-50367-37) BAILLY GENERATING STATION, NUCLEAR 1. Department of the Interior Recommends Withholding a Construction License Pending Review of Alternative Sites. (Department of the Interior, Washington, D. C. (USA)). 16 Apr 1973. 2p. Dep. NTIS $3.00.

1926 (DOCKET-50373-34) LA SALLE COUNTY STATION, UNITS 1 AND 2. Inspection Reports 050-373/73-01 and 050-374/73-01. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 4 Apr 1973. 11p. (Docket-50374-33). Dept. NTIS $3.00.

1927 (DOCKET-50400-38) SHEARON HARRIS NUCLEAR POWER PLANT, UNITS 1, 2, 3, AND 4. Draft Environmental Statement, Comments of U. S. Department of Agriculture. (Forest Service, Washington, D. C. (USA)). 5 Mar 1973. 2p. (DOCKET-50401-38; DOCKET-50402-38; DOCKET-50403-38). Dep. NTIS $3.00.

1928 (DOCKET-50404-48) NORTH ANNA POWER STATION, UNITS 3 AND 4. Safety Evaluation, Supplement 2. (Directorate of Licensing (AEC), Washington, D. C.). Apr 1973. 25p. (DOCKET-50405-48). Dep. NTIS $3.25.

1929 (DOCKET-50404-49) NORTH ANNA POWER STATION, UNIT 3. Margin in Design Pressures Specified for Subcompartments. (Virginia Electric and Power Co., Richmond). 20 Apr 1973. 1p. Dep. NTIS $3.00.

1930 (DOCKET-50409-45) LA CROSSE BOILING WATER REACTOR. Monthly Operating Report for January 1973. (Dairyland Power Cooperative, La Crosse, WI). 1973. Contract AT(11-1)-851. 28p. (DPC-851-54). Dep. NTIS $3.50.

1931 (DOCKET-50410-25) NINE MILE POINT NUCLEAR STATION, UNIT 2. Preliminary Safety Analysis Report, Supplement 9. (Niagara Mohawk Power Corp., Syracuse, N. Y.). 5 Apr 1973. 252 p. Dep. NTIS $14.75.

Revised and requested data are presented concerning the quality assurance program, piping systems, structures, auxiliary systems, radioactive waste systems, electrical system, instrumentation, containment, and reactor site. (DCC)

1932 (DOCKET-50410-26) NINE MILE POINT NUCLEAR STATION, UNIT 2. Preliminary Safety Analysis Report, Supplement 10. (Niagara Mohawk Power Corp., Syracuse, N. Y.). 17 Apr 1973. 224p. Dep. NTIS $13.25.

Revised and requested information on the Nine Mile Point Nuclear Station, Unit 2 is presented under the following main headings: site, buildings and structures; reactor physics; cooling system; instrumentation; electrical system; radiation protection; and safety analysis. (JWR)

1933 (DOCKET-50410-27) NINE MILE POINT NUCLEAR STATION, UNIT 2. Draft Environmental Statement, Response to Comments by Various Agencies. (Niagara Mohawk Power Corp., Syracuse, N. Y.). 18 Apr 1973. 157p. Dep. NTIS $10.00.

1934 (DOCKET-50413-12) GRAND GULF NUCLEAR STATION, UNITS 1 AND 2. Comparative Statistics on the Immediate Impact Area and the State. (South Carolina State Development Board, Columbia (USA)). 8 Mar 1973. 65p. (DOCKET-50414-12). Dep. NTIS $5.25.

1935 (DOCKET-50413-14) CATAWBA NUCLEAR STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 6. (Duke Power Co., Charlotte, N. C.) 20 Apr 1973. 12p. (DOCKET-50414-14). Dep. NTIS $3.00.

Requested additional information on the containment pressure response analysis for a steam line break accident is presented. (JWR)

1936 (DOCKET-50416-21) GRAND GULF NUCLEAR STATION, UNITS 1 AND 2. Inspection Reports 50-416/73-1 and 50-417/73-1. (Mississippi Power and Light Co., Jackson (USA)). 17 Apr 1973. 16p. (DOCKET-50417-21). Dep. NTIS $3.00.

1937 (DOCKET-RESARA-16) WESTINGHOUSE NUCLEAR STEAM SUPPLY SYSTEM. Reference Safety Analysis Report. Volume X. Revision 3, Amendment 3, April 1973. (Westinghouse Electric Corp., Pittsburgh, PA. PWR Systems Div.). 16 Apr 1973. 292p. Dep. NTIS $16.75.

Revised information on the test program and mechanical and nuclear design of Westinghouse pressurized water reactors is presented. (JWR)

1938 (DOCKET-RESARA-17) WESTINGHOUSE NUCLEAR STEAM SUPPLY SYSTEM. Reference Safety Analysis Report. Volume XI. Revision 3, Amendment 3, April 1973. (Westinghouse Electric Corp., Pittsburgh, Pa. PWR Systems Div.). Apr 1973. 252p. Dep. NTIS $14.75.

Revised and additional information is presented concerning core physics, accident analysis, and technical specifications. (DCC)

1939 (DOCKET-RESARA-18) WESTINGHOUSE NUCLEAR STEAM SUPPLY SYSTEM. Reference Safety Analysis Report. Volume XII. Revision 3. (Westinghouse Electric Corp., Pittsburgh, PA. PWR Systems Div.). Apr 1973. 296p. Dep. NTIS $17.00.

Revised and additional information is presented concerning components, instrumentation, piping systems, and cooling system. (DCC)

1940 (DOCKET-RESARA-19) WESTINGHOUSE NUCLEAR STEAM SUPPLY SYSTEM. Reference Safety Analysis Report. Volume XIII. Revision 3. (Westinghouse Electric Corp., Pittsburgh, PA. PWR Systems Div.). Apr 1973. 256p. Dep. NTIS $15.00.

Revised and additional information is presented concerning the engineered safeguards, instrumentation, and control system. (DCC)

1941 (DOCKET-RESARA-20) WESTINGHOUSE NUCLEAR STEAM SUPPLY SYSTEM. Reference Safety Analysis Report. Volume XIV. Revision 3. (Westinghouse Electric Corp., Pittsburgh, PA. PWR Systems Div.). Apr 1973. 249p. Dep. NTIS $14.50.

Revised and additional information is presented concerning remote handling equipment, cooling system auxiliaries, and the radioactive waste processing system. (DCC)

1942 (DOCKET-RESARA-21) WESTINGHOUSE NUCLEAR STEAM SUPPLY SYSTEM. Reference Safety Analysis Report. Volume XV. Revision 3. (Westinghouse Electric Corp., Pittsburgh, PA. PWR Systems Div.). Apr 1973. 209p. Dep. NTIS $12.50.

Revised and additional information is presented concerning accident analysis and the quality assurance program. (DCC)

1943 ACTION ON REACTOR AND OTHER PROJECTS UNDERGOING REGULATORY REVIEW OR CONSIDERATION. Blakely, J. P. (Comp.). Nucl. Safety; 14: No. 1, 51-71(1973).

The in-process license-application records of various power reactors and fuel-processing facilities are reported. Data for power reactors and processing facilities for which operating licenses have already been issued are given. The locations (as of Sept. 30, 1972) of the present and proposed civilian nuclear power plants for which reactor suppliers have been selected are shown. Recent regulatory and other actions relating to certain reactors and projects are summarized as of Oct. 1, 1972. Reactor projects for which the Atomic Safety and the Licensing Board (ASLB) hearings are in progress have been grouped together, as have been projects for which environmental reports, supplemental reports, and draft or final statements were made available. Individual reactor projects are listed alphabetically. (auth)

GENERAL

Energy Utilization and Economics

Refer also to abstracts 402 and 412.

1944 (EUR-4916) PRODUCTION OF ELECTROLYTIC HYDROGEN USING NUCLEAR ENERGY. Schenck, H.; Wenzel, W.; Block, F. R.; Wortberg, E. (Technische Hochschule, Aachen (West Germany)). Feb 1973. 30p. (In German). Dep. NTIS (U. S. Sales Only). EUR BF 80,-.

The present supplementary study deals with the possibilities of producing hydrogen by means of water electrolysis using cheap sources of nuclear energy and is intended as an additional aid in formulating a critical assessment of the possibilities already outlined in report EUR 4420. On the basis of existing methods, whereby hydrogen is produced as a result of the electrolysis of a potassium hydroxide solution (about 30% at 360°K) with two different electrolyzer arrangements, either in a unipolar or bipolar tank cell, new water electrolysis methods are described featuring, in particular, the Allis-Chalmers high-capacity electrolytic cell and the General Electric vapor phase cell. Details are given of the investment and production costs for the various hydrogen-producing processes involving the use of large electrolyzers. A comparison between the production costs of electrolytically produced hydrogen and hydrogen produced from fossil fuels shows that the former can compete on an equal basis, provided that the predictions concerning investment costs and energy consumption for a new generation of electrolytic cells are borne out. (auth)

1945 (JUL-886-WT) ASPECTS OF ELECTRICAL HIGH-ENERGY TRANSMISSION AND ITS INFLUENCE ON THE ENVIRONMENT. Sassin, W. (Kernforschungsanlage, Juelich (West Germany). Wissenschaftlich-Technische Abt.). Aug 1972. 53p. (In German). Dep. NTIS (U. S. Sales Only) $4.75.

Within the next thirty years, many problems and obstacles will have to be solved and overcome, and quite decisive changes in the field of power supply are to be expected. Apart from the utilization of nuclear energy, which has been gaining ground during the last few years, dry-type cooling systems are very likely to be introduced within the next ten years, and the development in the ten to fifteen years to come will require the general use of new, more efficient types of cables. Suggestions such as those put forward by Garwin and Matisoo, who in 1967 proposed to install a superconducting dc cable with 100,000-MW transmission capacity from the east to the west coast of the U. S. A., or the current investigations on power-station pools with an overall capacity of 20,000 MW and reactors generating about 5,000 MW are valuable contributions, mainly because they clearly show the limits inherent in future technical developments. Those actual limits are set by the constraints of economic facts, by the equilibrium of ecological systems and, in the long run, by the priority of values set up by our civilization. A characteristic feature of an electrical power supply system is the long serviceable life of its installations and the low rate of innovation. This is why the impact of these innovations on the environment and the population of the future will be more determined by what is presently being invested and constructed than by completely new technologies and procedures. (GF)

1946 (NP-19675) POWER GENERATION ALTERNATIVES. 2nd Edition. (Seattle Dept. of Lighting, Wash. (USA)). Oct 1972. 175p. Cone-Heiden Corp. $5.00.

The decision by a utility to utilize a particular method of generating electricity to suit their particular circumstance is a complex one, which in its most elemental form involves selection of the most desirable—or perhaps more aptly—the least undesirable alternative. Available energy resources, time available, the state of technology, the magnitude of need, local geography, the nature of system demand, the characteristics of other generation facilities on the same system, economics, and numerous other important factors—including environmental effects—influence utility decision-makers. (auth)

1947 (ORNL-HUD-27) LEGAL ASPECTS OF UNDERGROUND UTILITIES. Brown, W. H. (Oak Ridge National Lab., Tenn.). Apr 1973. Contract W-7405-eng-26. 25p. Dep. NTIS $3.00.

The legal ramifications to the expanding emphasis on underground utilities were examined. Compulsory undergrounding was studied from the standpoint of those factors recognized as justifying such compulsion. Possible liability problems were explored. Undergrounding involves delegation of authority. Each state can choose to determine a statewide policy on utilities or to delegate regulation of utilities to local governmental units. The direction that the legal systems may take are enumerated. (JCW)

1948 (PB-207516) ENERGY RESEARCH NEEDS. Schurr, S. H. (Resources for the Future, Inc., Washington, D. C. (USA)). Oct 1971. 880p. GPO.

This report identifies a large number of individual matters on which research is needed in order to gain an improved understanding of the long-term energy problem of the United States, and in order to devise policies to deal with the situation. The broad subjects are the forces that influence consumption, the future of domestic mineral fuel reserves, research and development possibilities in energy production and use, the environmental impacts of energy production and utilization activities, and the public policies that significantly affect energy industry operations. (auth)

1949 (UCRL-51366) TOTAL FLOW CONCEPT FOR RECOVERY OF ENERGY FROM GEOTHERMAL HOT BRINE DEPOSITS. Austin, A. L.; Higgins, G. H.; Howard, J. H. (California Univ., Livermore. Lawrence Livermore Lab.). 3 Apr 1973. Contract W-7405-eng-48. 41p. Dep. NTIS $3.00.

A new method for producing electrical power from the energy stored in hot brine deposits is described. Of the three forms of geothermal energy, the hot brine resource has the greatest potential for development of a viable long-range geothermal energy supply. It is a large energy source with recovery and conversion requiring only moderate extensions of existing technologies. The proposed method is developed specifically for application to the brines of the Salton Sea geothermal area, where enough energy is stored to provide at least 100,000 MW electrical generation capacity for more than 20 yr. The method uses the total flow concept. Hot brine is allowed to expand (from 300°C, 2200 psia, at ~5000 ft) to the surface where the wellhead product contains ~20% vapor by weight and ~560 Btu/lb at ~400 psia. This thermal energy is converted to kinetic energy by expansion of the mixture through a converging-diverging nozzle. The high velocity output is used to drive a modified hydraulic impulse turbine operating at ~3.5 in. Hg (120°F). It is estimated that an electrical power generation station using this concept will require a capital investment of ~$200/kW and should produce power at a cost of ~3 mills/kWh. (LMT)

1950 ENERGY: NEW DIRECTIONS AND CHALLENGES. Bechtel, S. D. Jr. (Bechtel Corp., San Francisco). Nucl. News; 16: No. 5, 42-50; 52-54(Apr 1973).

The present and future energy picture is discussed. It is suggested that near term requirements will be met by importing crude oil, fuel oil, and petroleum; additional fossil fuel power-generating plants; coal transportation by coal-slurry pipelines; and acceptance of less pollution control. Between 1980-1995, conventional nuclear plants and substitute natural gas, liquified natural gas, and coal gasification will be possible energy sources. By 1995 and thereafter the breeder reactor, fusion reactor and solar energy are suggested and discussed as possible energy sources. (FS)

1951 PROBLEMS AND OPPORTUNITIES IN WASTE HEAT DISPOSAL. Swidler, J. C. (Public Service Commission, Albany). pp 132-138 of Conference on Beneficial Uses of Thermal Discharges. Mathur, S. P. (ed.). Albany; State University of New York (1970).

From conference on beneficial uses of thermal discharges; Albany, New York, USA (17 Sep 1970). See CONF-700986-.

It is predicted that technological improvements will offer mechanisms for waste heat transfer other than the use of surface waters and at the same time achieve higher levels of efficiency in power generation. These advances will reduce the problem of thermal pollution of surface waters. Possible uses of power plant waste heat suggested include use for more power generation, use for space heating and air conditioning, and use for industrial production. (CH)

1952 BENEFICIAL USE OF HEAT IN ICELAND. Technical and Economical Aspects and Future Prospects. Matthiasson, M. pp 139-184 of Conference on Beneficial Uses of Thermal Discharges. Mathur, S. P. (ed.). Albany; State University of New York (1970).

From conference on beneficial uses of thermal discharges; Albany, New York, USA (17 Sep 1970). See CONF-700986-.

The use of geothermal energy in Iceland has more than doubled in the last decade and is expected to do so during the next. The utilized heat energy during 1970 was 8.8 10^{12} BTU/year, mainly used for district heating, some 80,000 people or 40% of the population (200,000) at a cost of 1 $/$10^6$ BTU at the user, the green-

house farming, with some 115,000 m2 under glass at 0.11 $/10^6 BTU. Other uses included: industrial users, mainly the Diatomic Earth Plant, yearly production 24,000 tons metric at utilizing geothermal steam 53 tons metric/h at 90 psig at cost of 0.15 $/10^6 BTU at the plant and electric power production, where a 3.5 mW turbine was operated on geothermal steam. When operated as base load (8,000 h/year) the generating cost is 2.9 mill/kWh. Among future prospects are: the production of chemicals from brine and seawater and heavy water production. (CH)

Information Handling

1953 (EANDC-91-U) SIXTH BIENNIAL REPORT ON THE ACTIVITIES OF THE EANDC. Havens, W. W. Jr.; Cross, W. G. (European-American Nuclear Data Committee). Nov 1972. 30p. Dep. NTIS (U. S. Sales Only) $3.25.

This basically administrative report lists the following topics in the table of contents: Introduction; A brief history of the EANDC and its accomplishments through 1970; Responsibilities of the EANDC; Accomplishments; Highlights of the EANDC accomplishments in 1970 and 1971; Meetings of the EANDC; Modification of the EANDC terms of reference; Nuclear data; Request list; Samples; Relations of the EANDC with other organizations; and The future of the EANDC. Six appendices include the following: EANDC meetings; International conferences sponsored by EANDC; Members of the EANDC for the biennial period 1970–72; EANDC terms of reference as adopted at the fifteenth meeting; List of EANDC documents issued since the 13th EANDC meeting (October 1969); Letter transferring RENDA to the INDC. (RWR)

1954 (LBL-1261) DEVELOPMENT OF A COMPUTER-BASED NUCLEAR DATA COMPILATION: TABLE OF ISOTOPES. Lederer, C. M.; Hollander, J. M. (California Univ., Berkeley. Lawrence Berkeley Lab.). Feb 1973. Contract W-7405-eng-48. 18p. (CONF-730302-7). Dep. NTIS $3.00.

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973).

Based on a proposal by the authors in 1968, computer techniques are being developed for application to the production of the next (7th) and future editions of the Table of Isotopes. The use of computers is intended to accomplish several goals: to reduce the probability of errors and simplify the compiler's job by improvements in the data-input procedure, by computer checks for all possible machine-detectable errors in the syntax and in the physics of the input data, and by elimination of redundant entry and proofreading of data reused in succeeding editions of the Table of Isotopes; to shorten the time delay between the cut-off data for acceptance of new literature and the publication of the compilation by nearly complete automation of the production process; to enable production of automatically sorted or inverted compilations, such as tables of gamma rays from all isotopes produced by neutron capture in natural targets, ordered by energy; to eliminate redundant entry of abstracted data by different compilers whenever possible. An important part of the computer automation is the development of a text input and editing system for direct keyboarding of complex text. This system is being used for input of all tabular data. Graphical data (level schemes) are entered in tabular form on punched cards and plotted by computer. A major saving in effort and improvement in accuracy should thus be obtained, because level schemes can be modified easily and redrawn automatically, without the need for extensive drafting and redundant proofreading. (5 figures) (auth)

1955 (LBL-1262) SURVEY OF NUCLEAR DATA USE IN APPLIED FIELDS. Lederer, C. M.; Hollander, J. M. (California Univ., Berkeley. Lawrence Berkeley Lab.). Feb 1973. Contract W-7405-eng-48. 16p. (CONF-730302-8). Dep. NTIS $3.00.

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973).

In connection with compilation activities for the Table of Isotopes, a survey of nuclear data needs outside the field of basic nuclear science is being conducted, principally among users of radioisotopes. Questionnaires are being mailed to people in such diverse fields as medicine, environmental studies, and oceanography. The questions are intended to ascertain what sources of data are used, what specific types of data are required, to what extent existing compilations fill these needs, and what changes are needed or desired. Several questions at the end of the list concern specifically the use of the Table of Isotopes. A preliminary summary of the response to date to the survey is discussed. (8 figures) (auth)

Law

Refer also to abstract 674.

Management

1956 (AECL-3552) SERIAL HOLDINGS, MAIN LIBRARY, ATOMIC ENERGY OF CANADA LIMITED, Compiled in November 1972. Greenshields, H.; Keating, C. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Feb 1973. 75p. Dep. NTIS (U. S. Sales Only) $5.75.

This is a list of titles of journals, yearbooks, directories and other serial publications held in the AECL Main Library which operates as the Canadian national repository for nuclear literature. The listing is alphabetical and indicates the volumes and parts of volumes held in the library. Three appendices identify abstract sources, reference sources and translated periodicals. (auth)

1957 (DP-929(Rev. 2)(Suppl. 1)) PUBLICATIONS, 1972. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). 1972. 14p. Dep. NTIS $3.00.

This compilation includes research and development reports, journal articles, contributions to books, computer programs, and other items published by Du Pont under its contract with the Atomic Energy Commission. The information was compiled by machine methods to produce bibliographic, subject, and author listings. This supplement updates the information included in DP-929, Rev. 2, Publications, 1951 through 1971, to include 1972. (auth)

1958 (KFK-EXT-8/72-5) CONTRIBUTION TO PRINCIPLES OF COMPUTER-AIDED DESIGN AND DESIGN LANGUAGES. Leinemann, K.; Schumann, U. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Feb. 1973. 84p. (In German). Dep. NTIS. (U. S. Sales Only) $6.25.

A study of the potential profit gained from computer-aided design shows three areas for beneficial application of EDP. An analysis of the development process describes the general structure of such processes and of the data files and algorithms needed. The variation of the description of technical objects in the course of the process is discussed in particular. A terminology to describe technical objects (especially its function) is proposed and defined by some specifically declared sets and relations. These sets and relations are arranged according to a principal structure of a data file for technical designing. The purpose of models for designing is investigated and some typical model classes are classified that are useful in many problem areas. The problem of data transfer from one model to the other is discussed. In conclusion, consequences for the development of computer aided design program systems are derived. (57 references) (auth)

1959 (NP-19701) CNEN ACTIVITY IN THE FIVE-YEAR PERIOD 1965–1969. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 15 Jan 1971. 402p. (In Italian). Dep. NTIS (U. S. Sales Only) $22.25.

CNEN activities for this period are summarized under the following sections: (1) General Direct Lines of the CNEN Activity — Finances and Costs; (2) Programs for Reactor Development; (3) Programs for the Nuclear Fuel Cycle; (4) Basic Technological Research; (5) Research on Effects and Applications of Radiations; (6) Research in Electronics, Applied Nuclear Physics, and Fundamental Physics; (7) Public Activity in Control in the Nuclear Field; (8) Foreign Relations — Education, Information, and Documentation Activities — Personnel; and (9) Internal Structure of the CNEN. Finally, a brief glossary of nuclear terms is presented. The report is enhanced by the generous use of figures, pictures, and drawings. (LMT)

1960 (NP-19708) CEKMECE NUCLEAR RESEARCH AND EDUCATION CENTER 1971 PROGRESS REPORT. Report No. 93. (Cekmece Nuclear Research and Training Center, Istanbul (Turkey)). 1972. 99p. (In Turkish). Dep. NTIS (U. S. Sales Only) $7.00.

During 1971, 63 research, application, development and service-type projects were initiated at the Cekmece Nuclear Research and Education Center. These activities were undertaken by several of the divisions of the Center: Health Physics (4 projects), Radioisotopes (3 projects), Reactor (2 projects), Electronics (15 projects), Radiobiology (19 projects), Nuclear Engineering (8 projects), Physics (9 projects) and Chemistry (projects). The program of each of these projects is discussed briefly. (TTT)

1961 (RHEL/M-118(Rev.)) REPORTS ISSUED BY THE RUTHERFORD HIGH ENERGY LABORATORY, 1960 to 1972. Marsh, E. (comp.) (Rutherford High Energy Lab., Chilton (England)). Jan 1973. 55p. Dep. NTIS (U. S. Sales Only) $4.75.

A list is given of publications issued during the period 1960 to 1972 by the Rutherford High Energy Laboratory, concerning NIMROD and all aspects of high-energy physics research carried out at the laboratory. (UK)

1962 GUIDE TO UKAEA DOCUMENTS. Fifth edition 1973. *Smith, J. R. (ed.). London; Her Majesty's Stationery Office* (1973). 48p.

Information is set out under headings: who issues U.K.A.E.A. documents; how information is made available; where documents may be seen or borrowed; lists of documents; commercially valuable information; general description of the current document series; current report numbering systems; U.K.A.E.A. subject bibliographies and reading lists; brief U.K.A.E.A. bibliography. In the appendix: numbering systems of expired series; check-list of expired series are given. Also included are: a list of reference publications; a list of booksellers of UK Government publications; a list of H. M. Stationery Office agents overseas. (UK)

Mathematics and Computers

Refer also to abstract 364.

1963 (AAEC/E-221) ACL-NOVA: A MULTI-USER CONVERSATIONAL INTERPRETER FOR THE NOVA COMPUTER. Sanger, P. L. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Jul 1972. 32p. Dep. NTIS (U. S. Sales Only).

A multi-user conversational interpreter for the NOVA computer is described. A new conversational language ACL, on which the interpreter is based, is also described. The interpreter uses the first 6¾K of a 12K NOVA computer and provides a very flexible arrangement for supporting a number of teletype terminals. The ACL-NOVA system provides a powerful conversational computing facility for many users in a time sharing environment. (auth)

1964 (AERE-R-6370) FORTRAN SUBROUTINE FOR GENERAL QUADRATIC PROGRAMMING. Fletcher, R. (Atomic Energy Research Establishment, Harwell (England)). Jun 1970. 19p. Dep. NTIS (U. S. Sales Only) $3.00. UK 2s. 6d.

A FORTRAN subroutine is described for minimizing a quadratic function of n variables subject to m linear equality and inequality constraints. The method is a general one so that there are no restrictions on the types of quadratic function which can be minimized. The solution is usually found in a moderate multiple of n^3 (or at worst n^2m) computer operations. The subroutine is very flexible and allows options which can considerably shorten the time taken to solve any particular problem. (auth)

1965 (AERE-R-7125) FORTRAN SUBROUTINES FOR MINIMIZATION BY QUASI-NEWTON METHODS. Fletcher, R. (Atomic Energy Research Establishment, Harwell (England)). Jun 1972. 34p. Dep. NTIS (U. S. Sales Only) $3.75. UK £1.00.

Two quasi-Newton subroutines for solving the problem of minimizing a function $F(\underline{x})$ of n variables $\underline{x}$ are presented. It is assumed that the gradient vector $\nabla F(\underline{x}) = \underline{g}(\underline{x})$ and the hessian matrix $G = [\partial^2 F/(\partial x_i \partial x_j)]$ exist. Two problems are referred to, namely that in which both $F(\underline{x})$ and $\underline{g}(\underline{x})$ can be calculated explicitly, and that in which only $F(\underline{x})$ can be calculated. In the latter case, a quasi-Newton method can only be implemented by approximating the derivatives $\underline{g}(\underline{x})$ by differences. (UK)

1966 (AERE-R-7298) FORTRAN SUBROUTINE FOR DETERMINING RAPIDLY WHETHER POINTS ARE INSIDE A PLANE REGION. Reid, J. K. (Atomic Energy Research Establishment, Harwell (England)). Dec 1972. 26p. Dep. NTIS (U. S. Sales Only) $3.50. UK 50 pence.

1967 (AERE-R-7308) FORTRAN SUBROUTINE FOR CALCULATING A CUBIC SPLINE APPROXIMATION TO A GIVEN FUNCTION. Powell, M. J. D. (Atomic Energy Research Establishment, Harwell (England)). Dec 1972. 26p. Dep. NTIS (U. S. Sales Only) $3.50. UK 50 pence.

Given a real function f(x), $a \le x \le b$, and a positive tolerance ϵ: suppose that the value of f(x) can be calculated for any x in [a,b]. This report presents a Fortran subroutine for calculating automatically a cubic spline function, s(x) say, that satisfies the condition $|f(x) - s(x)| \le \epsilon$, $a \le x \le b$. The method used is the one described by Curtis and Powell (AERE-R-5602), which aims to calculate *s(x) using few evaluations of f(x).* (auth)

1968 (ANL-7411(Suppl.7)) ARGONNE CODE CENTER: COMPILATION OF PROGRAM ABSTRACTS. Butler, M. K.; Henline, P.; Hughes, C. E.; Legan, M.; Ranzini, L.; Snow, W. J. (Argonne National Lab., Ill.). Jan 1973. Contract W-31-109-eng-38. 114lp. Dep. NTIS $7.60.

This supplement contains revisions and additions to the abstracts at the Argonne Code Center. A revised KWIC index and Library Programs by Classification are also included. (RWR)

1969 (BDX-613-813) NONLIN: A COMPUTER PROGRAM FOR LEAST-SQUARES ESTIMATION OF NONLINEAR PARAMETERS AND APPLICATIONS. Neal, B. J. (Bendix Corp., Kansas City, Mo.). Dec 1972. Contract AT(29-1)-613. 40p. Dep. NTIS $4.00.

A computer program, NONLIN, which determines the least-squares estimates of the unknown parameters in a nonlinear model was developed. The mathematical basis of Marquardt's compromise algorithm, the computing procedure used in NONLIN, is described in detail. Applications of NONLIN are given. (auth)

1970 (COO-1469-219) NOTE ON THE NONEXISTENCE OF MULTIVALUE A-STABLE METHODS OF ORDER GREATER THAN TWO. Gear, C. W. (Illinois Univ., Urbana. Dept. of Computer Science). Mar 1973. Contract AT(11-1)-1469. 6p. (UIUCDCS-R-73-569). Dep. NTIS $3.00.

It is shown that the Dahlquist result limiting the order of A-stable multistep methods also applies to multivalue methods. (auth)

1971 (COO-2118-41) ILLIAC III COMPUTER SYSTEM MANUAL: ARITHMETIC UNITS. Volume 2, Goyal, L. N. (Illinois Univ., Urbana. Dept. of Computer Science). Jan 1973. Contract AT(11-1)-1469. 316p. (UIUCDCSR-73-551). Dep. NTIS $18.00.

1972 (KFK-1674) DESIGN CHARACTERISTICS FOR CAMAC MODULES ACCORDING TO THE REVISED SPECIFICATION EUR 4100 e (1972). Heep, W.; Ottes, J.; Tradowsky, K. (Kernforschungszentrum, Karlsruhe (West Germany). Labor fuer Elektronik und Messtechnik). Jan 1973. 27p. (In German). Dep. NTIS (U. S. Sales Only) $3.50.

Following the revised specification EUR 4100 e (1972), general rules for developing CAMAC modules are given. These guidelines give hints to the designing engineer and make possible compatible software for all modules. This paper replaces KFK-EXT-22/71-6. (MOW)

1973 (KFK-1688) CAMAC INPUT/OUTPUT MODULES FOR BINARY SIGNALS. Heep, W.; Hellmann, G.; Stiefel, W. (Kernforschungszentrum, Karlsruhe (West Germany). Labor fuer Elektronik und Messtechnik). Jan 1973. 20p. (In German). Dep. NTIS (U. S. Sales Only) $3.00.

Four CAMAC Input/Output Modules for binary signals are described. The module Digitalausgabe (Digital Output) type LEM-52/31.1. contains 24 relays with two contacts, the module Digitaleingabe (Digital Input) type LEM-52/30.1. 24 relays with one contact. The module Spontane Digitaleingabe (Edge Triggered Digital Input) type LEM-52/29.1. contains 24 relays. In this module each change of an input signal causes an interrupt signal. The module Interrupteingabe (Interrupt Input) type LEM-52/28.1. allows 12 interrupt signals to be switched to the computer. (auth)

1974 (KFK-1711) PL/1 SUBROUTINE PACKAGE FOR DISCRETE EVENT SIMULATION. Nehmer, J.; Hilse, D.; Rupp, M.; (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Datenverarbeitung in der Technik). Jan 1973. 37p. (In German). Dep. NTIS (U. S. Sales Only) $4.00.

The expense for construction simulation models may be reduced noticeably by providing a library subroutine package supporting the basic operations for time synchronization and random number generation. In this report a subroutine package for discrete event simulation in PL/1 is described running on the IBM 360/370 configuration of the KFZK. (auth)

1975 (NVO-1253-4) NV STATPAC USERS GUIDE. User Information Bulletin 3. Jun 1972. Contract AT(29-2)-1253. 19p. Dep. NTIS $3.00.

The STATPAC System is a collection of computer programs for the reduction and statistical analysis of data which can be presented in the form of a two-dimensional matrix. To access the desired STATPAC routines a deck of precisely completed control cards must be submitted to the computer. Instructions for completion of necessary control cards and examples of several control card decks are provided as User Guides. (auth)

1976 (SC-DR-68-815) SIDCAP REPORT NO. 5. Algorithms to Link Scan Data into Ordered Contours and Topological Algorithms: LINK, LOOP, SURR, and TYPE. Lindsay, B. W.; Morrison, D. R. (Sandia Labs., Albuquerque, N. Mex.; New Mexico Univ., Albuquerque; Los Alamos Scientific Lab., N. Mex.). Jan 1973. 46p. Dep. NTIS $4.50.

This is the fourth of a series of documents which describe SIDCAP (Sandia Image Digitizer, Connector, Analyzer, and Plotter). SIDCAP is a system of computer hardware and software assembled in Sandia's Computer Science Division to provide a graphic input capability to the computer. SIDCAP views black and white plane figures, computes their size, shape, and orientation, and compares these with the size, shape, and orientation of other figures. It is,

in other words, a pattern recognition system. This document deals with the software algorithms which connect points detected by the hardware (digitizer) into contours of ordered points and determines their related topology. (auth)

1977 (SLA-73-333) CDC 6600 CODES FOR SOME CUMULATIVE, UNIVARIATE DISTRIBUTION FUNCTIONS. Amos, D. E.; Daniel, S. L. (Sandia Labs., Albuquerque, N. Mex.). Feb 1973. 87p. Dep. NTIS $6.50.

A listing of some univariate distribution functions, their calling sequences, and programs are presented with appropriate comments concerning the implementation of published references. These include the normal, beta, F, chi-square, central and noncentral t, the doubly noncentral t, the noncentral chi-square distribution, the circular coverage function, and the T(h,a) function of Owen. (auth)

1978 (SLL-73-221) USERS' MANUAL FOR SPL250. Saltgaver, R. K. (Sandia Labs., Albuquerque, N. Mex.). Mar 1973. 14p. Dep. NTIS $3.00.

The code will fit a least-squares cubic spline to a set of data points and has the capability to display the data points, the first derivative, the second derivative, the spline fit, and the difference between the spline approximation and the original data points. The user can change the scales to look at a local area of the curve. Knots can be inserted and deleted by console action. At each knot, monotonicity and concavity constraints can be applied. The spline approximation can be saved on punch cards and can also be plotted on 35-mm film along with plots of the first and second derivatives and the difference curve. The following constraints may be applied, singly or in combination, at each end of the curve: (1) spline passes through end point(s); (2) first derivative has specified value at end point(s); (3) second derivative has specified value at end point(s). (auth)

1979 (UCLA-10-P-14-114) DESIGN OF AN EXTENSIBLE PROCESSOR. Wingfield, M. A. (California Univ., Los Angeles. Dept. of Computer Science). Sep 1972. Contract AT(11-1)-Gen-10. 339p. (UCLA-ENG-7250). Dep. NTIS $19.00.

Thesis.

An extensible processor is defined to be a computer system which is sufficiently modular to allow not only the attachment and replacement of computational subsystems but also the inclusion of built-in measurement facilities. These features provide an environment for the controlled growth of computational power. The quantum of change in the extensible processor has been defined to be the procexx, a model of the process and related attributes. The procexx model is independent of implementation and includes a description of the algorithm, the input and output data sets, and the sets of control entry and exit points. Various algorithms are given which decompose procexxes which are defined in terms of the UCLA graph model of computations. A set of primitive operations are defined which direct the interactions between processes. These include transfer of control and data as well as operations formerly performed by operating systems. A design for measurement nodes as an integral component of the extensible processor is presented. The modularity introduced by the procexxes enables the definition of a set of standard measurement parameters through which varying experiments can be performed. A kernel machine is defined as the initial component of the extensible processor which executes the set of primitive operations. The algorithms associated with each primitive are given in terms of their interaction with a set of tables resident in the kernel machine. Various experiments are given which exercise a subset of primitives as well as indicate typical operation of the system. A subset of the primitives was simulated through the use of a simulation language under development at UCLA. (auth)

1980 (Y-1865) TWO-AXIS MACHINE TOOL CONTROL WITH A DEDICATED MINICOMPUTER. Williams, T. L.; Burkhardt, J. H. Jr.; Lay, C. M.; Stephens, A. E. (Oak Ridge Y-12 Plant, Tenn. (USA)). 9 Feb 1973. Contract W-7405-eng-26. 51p. Dep. NTIS.

A control system for a two-axis turning machine was developed using a minicomputer. This endeavor was initiated in order to determine the assets and liabilities of stored part description, open-loop digital servos, and the overall concept of computerized numerical control (CNC) of a machine tool. The resulting system displayed machining accuracies similar to standard commercial numerical control units which use finer pulse resolution and have analog servos with closed-loop feedback. The CNC system also exhibits better reliability and long-term position repeatability than the standard NC systems. (auth)

1981 OPTIMIZATION. Anderssen, R. S.; Jennings, L. S.; Ryan, D. M. (eds.). Canberra; Australian National University (1972). 227p.

Unconstrained optimization is considered with respect to function minimization, global optimization and statistical optimization, and constrained optimization with respect to projection methods, methods for nonlinear programming, integer programming, dynamic programming, and optimal control theory. Emphasis is given to the provision of practical illustrations of the techniques considered. A further paper on derivative methods for unconstrained problems is included to complement the presented material. (AT)

Miscellaneous

1982 (AECL-4216) DYNAMIC FATIGUE BEHAVIOUR OF POCO AND RC4 GRAPHITES AND A GENERAL FATIGUE DESIGN CRITERION. Wilkins, B. J. S.; Reich, A. R. (Atomic Energy of Canada Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment). Jul 1972. 22p. Dep. NTIS (U. S. Sales Only). AECL $0.50.

1983 (AECL-4371) APPROXIMATE EXPRESSION OF THE THREE HALVES LAW FOR A BOUNDED CATHODE IN A UNIFORM FIELD (INTRODUCED BY ACADEMICIAN N. N. SEMENOV 3 JULY 1952). Levintov, I. I. Translated by J. A. Hulbert (Chalk River Nuclear Labs., Ontario) from Dokl. Akad. Nauk SSSR; 85: No. 6, 1247-1250(1962). 11p. Dep. NTIS (U. S. Sales Only) $3.00.

1984 (AEEW-R-835) STATISTICAL CHARACTERISTICS OF OBSERVED GRID FREQUENCY VARIATIONS USING THE PROGRAM SAMPAN. Cummins, J. D.; Green, M. A. (Atomic Energy Establishment, Winfrith (England)). Nov 1972. 40p. Dep. NTIS (U. S. Sales Only) $4.00.

1985 (AERE-R-7304) HOT WIRE ANEMOMETER WELDING ASSEMBLY. Benn, D. (Atomic Energy Research Establishment, Harwell (England)). Feb 1973. 15p. Dep. NTIS (U. S. Sales Only) $3.00. UK 50 pence.

1986 (AERE-R-7341) DEVICE FOR THE TRACKING AND DATA PROCESSING OF EVENTS RECORDED ON VIDEO-TAPE. Thomas, R. B.; Benton, G. H. (Atomic Energy Research Establishment, Harwell (England)). Feb 1973. 25p. Dep. NTIS (U. S. Sales Only) $3.25. UK 50 pence.

1987 (ANL/ES-14) METHODOLOGY FOR CONTROLLING AIR POLLUTION EPISODES. Wolsko, T. D.; Matthies, M. T.; King, R. F. (Argonne National Lab., Ill.). Sep 1972. Contract W-31-109-eng-38. 209p. Dep. NTIS $3.00.

1988 (AREAEE-152) STABILITY OF ELECTROMAGNETIC OSCILLATIONS IN MEDIA WITH CUBIC NONLINEARITY. Demchenko, V. V.; El-Siragy, N. M. (Atomic Energy Establishment, Cairo (Egypt). Dept. of Accelerators and Plasma Physics Research). 1972. 23p. Dep. NTIS (U. S. Sales Only) $3.25.

1989 (BARC-613) THERMODYNAMIC STUDY OF LIQUID COPPER-MAGNESIUM ALLOYS BY VAPOUR PRESSURE MEASUREMENTS. Garg, S. P.; Bhatt, Y. J.; Sundaram, C. V. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 32p. Dep. NTIS (U. S. Sales Only).

1990 (BARC-640) DEVELOPMENT OF PbS INFRARED DETECTORS. Ghosh, B.; Kothiyal, G. P. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 18p. Dep. NTIS (U. S. Sales Only) $3.00.

1991 (BDX-613-814) DETERMINATION OF HOLE LOCATION ON PRINTED CIRCUIT BOARDS. Taylor, R. D. (Bendix Corp., Kansas City, Mo.). Dec 1972. Contract AT(29-1)-613. 24p. Dep. NTIS $3.25.

1992 (BDX-613-871) STRENGTH MEASUREMENTS ON TRANSISTOR HEADER LEAD WELDS. Technological Spinoff Report. Siever, L. W. (Bendix Corp., Kansas City, Mo.). Mar 1973. Contract AT(29-1)-613. 21p. Dep. NTIS $4.00.

1993 (BDX-613-873) DETERMINING TRACE METALS IN GOLD DEPOSITS AND PLATING BATHS. Lantz, L. L. (Bendix Corp., Kansas City, Mo.). Mar 1973. Contract AT(29-1)-613. 14p. Dep. NTIS $3.00.

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2078 (UCRL-Trans-10675) BIOGEOCHEMISTRY OF MERCURY IN SOILS AND PLANTS. Malyuga, D. P.; Makhova, N. N.; Nikitina, R. G. Translated from Tr. Buryat. Inst. Estestv. Nauk, Buryat. Filial, Sib. Otd., Akad. Nauk SSSR; No. 2, 190-194(1969). 10p. Dep. NTIS $3.00.

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2080 (UCRL-Trans-10682) LINE WIDTH AND SPECTRAL COMPOSITION OF RADIATION FROM A PHOTODISSOCIATION LASER USING C_3F_7I. Volkov, V. N.; Zubarev, I. G. Translated from Kratk. Soobshch. Fiz.; No. 10, 10-16(1970). 8p. Dep. NTIS $3.00.

2081 (UH-235-P-9-11) PHOTOELECTRIC EMISSION FROM THIN FILMS IN THE VACUUM-ULTRAVIOLET REGION. Annual Progress Report, March 1, 1972–February 28, 1973. Pong, W. (Hawaii Univ., Honolulu. Dept. of Physics and Astronomy). 1 Mar 1973. Contract AT(04-3)-235. 53p. Dep. NTIS $4.75.

2082 (UR-3490-91) SPECIFIC G_1 PHASE TOXICITY OF CHLORAMPHENICOL ON MOUSE LEUKEMIC CELLS (L5178Y). Liberman, D. F.; Roti Roti, J.; Lange, C. S. (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). 1972. Contract AT(30-1)-4284. 18p. Dep. NTIS $3.00.

2083 (UR-3490-92) EFFECT OF CHLORAMPHENICOL ON THE GROWTH AND VIABILITY OF EXPONENTIALLY GROWING MOUSE LEUKEMIC CELLS (L5178Y). Liberman, D. F.; Roti Roti, J. L. (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). 1972. Contract AT(30-1)-4284. 20p. Dep. NTIS $3.00.

2084 (UR-3490-204) COUPLING BETWEEN Na^+ AND SUGAR TRANSPORT IN SMALL INTESTINE. Kimmich, G. A. (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). 1972. Contract AT(11-1)-3490. 98p. Dep. NTIS $7.00.

2085 (UR-3490-206) COMMENTS ON "COLLISIONS OF SMALL CLOUD DROPLETS: GAS KINETIC EFFECTS." Dahneke, B. (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). 16 Oct 1972. 4p. Dep. NTIS $3.00.

2086 VERSATILE HIGH PRESSURE APPARATUS FOR OPTICAL SPECTROSCOPY AT TEMPERATURES BETWEEN 77 AND 500 K (12 Feb 1973) (Engineering Materials). California Univ., Los Angeles). (CAPE-2328).
14 drawings.

2087 KORROZIYA I ZASHCHITA METALLOV. (Corrosion and the Protection of Metals). Chetverikov, A. V. (ed.). Kiev; Naukova Dumka (1972). 128p.
The following are presented: on theory and processes of the fast annealing, deposition technology of polymer coatings, corrosion resistance of structural materials in aggressive chloride media, as well as data on the electrochemical behavior of molybdenum, titanium, and other metals during anode polarization in chromium sulfate solutions. Results are also included from studies on the electroplating of corrosion-resistant indium-antimony and magnetic cobalt–nickel–phosphorus alloys with predetermined properties. The collection is intended for scientists and engineers working in the metallurgical, machine-building, chemical, food, and other industries dealing with the corrosion of metals and corrosion inhibitors. (29 references) (JPRS)

2088 CONTROL SYSTEM (17 MAR 1972) (ENGINEERING MATERIALS). (Los Alamos Scientific Lab., N. Mex.). (CAPE-2327).
21 drawings.

Appendix 1

SCOPE AND SECTION ARRANGEMENT OF NUCLEAR SCIENCE ABSTRACTS

Introduction

This publication defines the subject scope and arrangement of the literature in *Nuclear Science Abstracts (NSA)*. Broadly stated, the subject scope of *NSA* includes all of nuclear science and technology defined as follows:

> **Nuclear science is the study of the production, properties, and phenomena of atomic nuclei, subatomic particles, gamma rays, and nuclear x rays.**
>
> **Nuclear technology is the application of nuclear science to other sciences and engineering, and conversely, the application of other sciences and engineering to the problems of nuclear science.**

Part 1 identifies the major fields of nuclear science and technology into which *NSA* is divided. Subdivisions are listed under each field. Each subdivision is followed by statements of specific subject interest. These statements have been prepared to show the exact range and limits of subject interest for selecting literature abstracted and indexed in *NSA*.

Part 2 identifies the extent of interest in the chemical elements.

An index to Part 1 begins on page 22.

NSA covers reports, journals, books, patents, reviews, theses, conferences, and other similar literature. Selection is based on subject content; nothing is excluded solely on the basis of form, origin, or language. Some of the general practices followed in selecting literature for *NSA* are as follows:

1. **Popular type articles are not included.**
2. **Textbooks below the graduate level are not included.**
3. **Theses below the doctoral level are not included.**
4. **Patents that have been filed in several countries are included only once.**
5. **Material existing only as abstracts or short summaries is not included except for papers summarized in the *Transactions of the American Nuclear Society*.**
6. **Material initially published in a language other than English may be included both when an item is published in the original language and when an item appears in an English language translation.**
7. **All U. S. Atomic Energy Commission research and development reports in printed form which have been made publicly available at the National Technical Information Service (NTIS) are included in *NSA*. Also included in *NSA* are the printed reports from the national nuclear energy organizations of the United Kingdom, Japan, Canada, Sweden, Denmark, Norway, Australia, and France which have been made publicly available at NTIS.**
8. **Related groups of engineering drawings and specifications are abstracted and indexed in *NSA* when they become publicly available.**
9. **As a general practice, material more than two years old is not included in *NSA*.**

A list of the journals scanned regularly and the abbreviations used appears in the January 15 issue of *Nuclear Science Abstracts* and is supplemented in the July 15 issue.

Part 1

SCOPE AND ARRANGEMENT

40.000 CHEMISTRY

40.100 Analytical and Separations Chemistry

[Analytical chemistry of isotopes, transactinides, actinides, lanthanides, Cs, I, Kr, Mo, Nb, Pm, Rn, Ra, Ru, Sc, Sr, Ta, Tc, Te, Xe, Y, Zr, or any element or compound if the application is directly associated with nuclear technology. Analyses to determine reactor fuel burnup; burnup calculations are included under REACTOR TECHNOLOGY. Arrangement is according to analytical procedure. Information relative to analytical methods is included as indicated.]

40.110 Activation and Nuclear Reaction Procedures

The subject in general or descriptions of the method.

40.120 Chemical and Spectral Procedures

40.130 Radiometric and Radiochemical Procedures

Nuclear radiometric or radiochemical procedure, including properties of radioisotopes as sources in x-ray analyses. Routine tracer studies are excluded.

40.140 Separation Procedures

Separation procedures for transactinides, actinides, lanthanides, Cs, I, Kr, Mo, Nb, Pm, Rn, Ra, Ru, Sc, Sr, Ta, Tc, Te, Xe, Y, Zr, and any material of interest in nuclear technology except the procedures covered elsewhere, e.g., under Activation Procedures, Reactor Fuel Reprocessing, and Radioactive Waste Treatment.

40.200 Inorganic, Organic, and Physical Chemistry

40.210 Chemical and Physicochemical Properties

Chemical and physicochemical properties of nonradioactive elements, compounds, or mixtures directly associated with nuclear technology. Also includes the preparation of radioprotective compounds.

40.220 Isotope Effects

Isotope effects on nonnuclear chemical and physical properties. Isotope effects are excluded when used only as a tool in the analysis of reaction mechanisms or in structure studies.

40.230 Isotope Exchange and Isotope Separation

Isotope exchange if the exchange is of primary concern or the exchange mechanism is used in isotope separation.

Chemical and physicochemical isotope separations are included here; but industrial scale processes such as gaseous diffusion and centrifugation are included under ISOTOPE AND RADIATION SOURCE TECHNOLOGY. Radioisotope production is included under Radiochemistry and Nuclear Chemistry.

40.240 Feed Materials Processing

Chemical processing of ores for recovery of uranium or thorium, including all extraction, conversion, or reduction steps. Also includes chemical engineering of plants for such processing, but site surveys and environmental impact are included under ENVIRONMENTAL AND EARTH SCIENCES.

40.300 Radiation Chemistry

[The radiations considered here include accelerated ions, gamma radiation, x radiation, bremsstrahlung, neutrons, protons, alpha particles, beta particles, deuterons, and other subatomic particles. Ultraviolet, infrared, and visible radiations are not included.]

Radiation effects on the chemical and physicochemical properties of any element, compound, or mixture. General papers on solvated electrons and hydroxyl radicals are also included. Radiation effects on the biological activity of biochemicals in vitro or in vivo and all information on radiation effects on biochemicals in living organisms are included under LIFE SCIENCES. Radiation effects on metallurgical or solid state properties are included under MATERIALS or PHYSICS (SOLID STATE).

40.400 Radiochemistry and Nuclear Chemistry

Radiochemistry and nuclear chemistry are included without restrictions except for tracer applications and labeled compound preparation, which are included only if there is a contribution to the technology. Include those items that detail the technology, but exclude those in which no change in methodology is indicated.

40.410 Hot-Atom Chemistry

Any aspect, including recoil production and reactions.

40.420 Properties of Radioactive Materials

Chemical and physicochemical properties of radioactive elements or materials, including the stability of labeled compounds and chemical decontamination of surfaces or work areas. Decontamination of reactor vessels following accidents is included under REACTOR TECHNOLOGY.

40.430 Radioactive Waste Treatment

Radioactive waste processing for concentration, decontamination, or fission product recovery.

Waste disposal monitoring is included under ENVIRONMENTAL AND EARTH SCIENCES; waste disposal is included

under NUCLEAR MATERIALS AND WASTE MANAGEMENT.

40.440 Radioisotope Production

Radioisotope production processes involving chemical separations. Development and uses of radioisotope radiation sources are included under ISOTOPE AND RADIATION SOURCE TECHNOLOGY.

40.450 Reactor Fuel Reprocessing

Reactor fuel processing, including analytical control, chemical separations, solvent studies, and plant and process design, performance, and operation. Environmental monitoring and impact are included under ENVIRONMENTAL AND EARTH SCIENCES.

42.000 ENGINEERING

42.100 Energy Conversion

Equipment and methods for the conversion of energy directly into electric energy, e.g., thermionic, thermoelectric, MHD, etc., and the production of electric energy through novel or previously undeveloped technology. Energy conversion economics is included under GENERAL-Energy Economics.

42.200 Facilities and Equipment

Nuclear facilities and equipment for which no more appropriate category has been provided. In general, information on facilities and equipment is included under categories more closely related to the purpose of the facility or equipment, e.g., CHEMISTRY, PARTICLE ACCELERATORS, REACTOR TECHNOLOGY. Remote-handling equipment is included under NUCLEAR MATERIALS AND WASTE MANAGEMENT.

42.300 Heat Transfer and Fluid Flow

Heat transfer and fluid flow if nucleate boiling, boiling burnout, critical heat flux, two-phase flow, flow in rod bundles, or liquid metals are considered. Heat transfer or fluid flow applied in nuclear technology is included under sections for the application.

42.400 Materials Testing

Destructive or nondestructive materials testing if a direct application to nuclear technology is indicated and if categorization on the basis of application would be less appropriate. In general, information on component testing is included under categories more closely related to the component, e.g., information on reactor fuel element testing is included under REACTOR TECHNOLOGY.

The use of radioisotopes and radiation sources in radiographic or radiometric testing is included under ISOTOPE AND RADIATION SOURCE TECHNOLOGY.

42.500 Nuclear Explosions

Detection of nuclear explosions and civil uses of nuclear explosions, including simulations using non-nuclear explosives.

42.600 Protective Structures and Equipment

Structures and equipment designed primarily for equipment and personnel protection, e.g., blast and fallout shelters, shielding (except for accelerator and reactor shielding), clean rooms, air filtration systems, fire protection systems, masks, and special clothing. The fabrication of bulk shielding is included under MATERIALS, shielding calculations are included under PHYSICS (RADIATION AND SHIELDING), and remote-handling equipment is included under NUCLEAR MATERIALS AND WASTE MANAGEMENT.

42.700 Safety Engineering

Safety at nuclear facilities if no more appropriate category is provided. In general, safety engineering information is included under categories for specific activities or facilities, e.g., Nuclear Explosions or REACTOR TECHNOLOGY.

42.800 Vacuum Engineering

Ultrahigh (10^{-9} torr or greater) vacuum systems and equipment if no nuclear application is indicated. Applied vacuum engineering is included under categories for the applications, e.g., PARTICLE ACCELERATORS.

44.000 ENVIRONMENTAL AND EARTH SCIENCES

44.100 Minerals and Ores

Identification, properties, prospecting, mining, and estimated reserves of thorium and uranium minerals and ores (including equipment). Chemical processing of ores is included under CHEMISTRY.

44.200 Radioactive Effluents

Concentration or levels of radioactive materials discharged to the natural environment (atmosphere, soil, and waters) under accident or normal operating conditions at nuclear facilities.

44.300 Radioactivity Monitoring and Transport

Monitoring and/or transport and distribution of radioactive materials (including natural radioactivity) in or through the atmosphere, soil, or waters of the earth. Also includes monitoring and radiation hazards presented by radioactive materials in ecosystems or food cycles. Instrumentation for monitoring radioactivity is included under INSTRUMENTATION.

44.400 Radiometric Techniques

Use of radioisotopes or radiation sources in investigations of the environment or the earth, e.g., soil and water movement, isotopic methods of geochronology, etc., if the technique is of primary concern or is presented as an advancement of the technology. Instrument design is included under INSTRUMENTATION.

44.500 Site Surveys

Evaluation and selection of sites for nuclear installations such as fuel fabrication plants, radiochemical processing plants, and nuclear explosions. Seismological and background radiation surveys are included. Ecological studies of sites for nuclear facilities and sites for radiological research are also included. Nuclear power plant siting is included under REACTOR TECHNOLOGY.

44.600 Thermal Effluents

Characteristics, quantities, and effects of thermal discharges to the atmosphere, soil, or waters of the earth from

chemical plants, both fossil- and nuclear-fueled power plants, or any other facility with thermal discharges of the same order of magnitude.

44.700 Chemical Effluents

Characteristics, quantities and effects of nonradioactive chemical discharges to the atmosphere, soil, or waters of the earth from nuclear facilities such as reactors, gaseous diffusion plants, fuel reprocessing plants, etc. Chemical effluents considered in comparative studies of energy production methods are also included.

46.000 INSTRUMENTATION

46.100 Radiation Detection Instruments

Arrangement is as follows:
- General Detectors and Monitors
- Radiation Dosimeters
- Nuclear Spectroscopic Instrumentation (Includes Moessbauer spectrometers)
- High-Energy Physics Instrumentation

46.200 Radiometric Instruments

Any instrument employing a radiation source and/or radiation detector in its operation.

46.300 Radiation Effects on Instrument Components, Instruments, or Electronic Systems

46.400 Miscellaneous Instruments

Limited to instruments, instrument components, or instrumentation systems for application in nuclear technology.

47.000 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

47.100 Isotope Separation (Industrial)

Industrial processes for heavy water production, uranium *enrichment, or other isotope separation.*

47.200 Isotopic Power Sources

Use of radioisotopes (fission products) as sources of electric, propulsive, or thermal energy.

47.300 Radiation Sources

Design or fabrication of radiation sources, including neutron sources, but not accelerators or reactors. Use of radiation sources in industrial processes such as food processing, sterilization of medical supplies, polymer production, etc. Basic radiation effects are included under CHEMISTRY or LIFE SCIENCES, but information on radiation effects that influence product acceptability or marketability, such as color or taste, is included here.

48.000 LIFE SCIENCES

[For this section the term RADIATION is defined as nuclear particles, accelerated electrons and ions, and γ and x radiations. Information on uv effects is included *only* if microorganisms, cells, or biochemicals are the subjects of study. Laser radiation, magnetic fields, microwaves, and sunlight are excluded. The concept of RADIATION EFFECTS includes the effect itself, radiomimetic effects, and any information relating to the effect, e.g., information on assessment, prevention, alteration, transmission, reversal, recovery, etc., and information on the determination or influence of experimental variables such as dose, dose rate, LET, etc. This includes modification of radiation effects by radioprotective or effect-enhancing substances and studies on these substances to establish their independent effects. Theoretical aspects of dose determination or measurement in tissue equivalent materials or phantoms are included under PHYSICS (RADIATION AND SHIELDING).]

48.100 Radiation Effects on Biochemicals

Effects on biochemicals in living organisms and on their biological activity; information on other effects on biochemicals outside living organisms is included under CHEMISTRY. Also includes the preparation of materials for irradiation and irradiation procedures. The preparation of the radiation sources is included under CHEMISTRY or ISOTOPE AND RADIATION SOURCE TECHNOLOGY.

48.200 Radiation Effects on Cells

Effects of radiation from external or internal sources on cells in vitro, including cells in cultures; effects on in vivo cells are included in other LIFE SCIENCES categories for entire organisms. Also includes information on the preparation of materials for irradiation and irradiation procedures. The preparation of the radiation sources is included under CHEMISTRY or ISOTOPE AND RADIATION SOURCE TECHNOLOGY.

48.300 Radiation Effects on Microorganisms

Effects on microorganisms, including bacteria, protozoa, unicellular algae, fungi, and yeasts. Uses of radiation in industrial processes for the radiopreservation of food, radiosterilization of medical supplies, radiation preparation of vaccines, etc., are included under ISOTOPE AND RADIATION SOURCE TECHNOLOGY unless effects on specific organisms are considered.

48.400 Radiation Effects on Plants

Effects on plants (including multicellular algae and in vivo studies on plant cells), of external-source radiations including the preparation of materials for irradiation and irradiation procedures. The preparation of the radiation sources is included under *CHEMISTRY* or *ISOTOPE AND RADIATION* SOURCE TECHNOLOGY. Industrial processes for radiopreser*vation or disinfestation of foods is under ISOTOPE AND* RADIATION SOURCE TECHNOLOGY.

48.500 Radiation Effects on Animals

48.510 Man

Effects of external-source or implanted-source radiations on man or on human tissues or cells in vivo. Therapeutic *irradiation is included only if there is significant information* on the effects on normal tissues or if dose evaluations are made for new radiation sources, e.g., pion beams.

48.520 Vertebrates

Effects of external-source or implanted-source radiations on vertebrates or on vertebrate tissues or cells in vivo, including the preparation of animals for irradiation and irradiation procedures. The preparation of radiation sources is included under CHEMISTRY or ISOTOPE AND RADIATION SOURCE TECHNOLOGY.

48.530 Invertebrates

Effects on invertebrates or on invertebrate tissues or cells in vivo, including the preparation of the organism for irradiation and irradiation procedures. The preparation of radiation sources is included under CHEMISTRY or ISOTOPE AND RADIATION SOURCE TECHNOLOGY. Industrial scale processes for pest control and crop disinfestation are included under ISOTOPE AND RADIATION SOURCE TECHNOLOGY unless there is significant information on the effects of radiation on specific organisms.

48.600 Radionuclide Effects (Internal Source)

[Absorbed or incorporated radioactive materials, not implanted sources, in any in vivo studies.] Internal source evaluation and effects, including experimental procedures, but not the preparation of labeled compounds for administration.

48.700 Nuclide Kinetics and Toxicology

Kinetics and toxicology of deuterium and radionuclides in or on living organisms. Also includes contamination and decontamination, both internal and external, of living organisms. Levels and movement of radionuclides through man's environment are included under ENVIRONMENTAL AND EARTH SCIENCES.

48.800 New Tracer Techniques

Use of isotope tracers in LIFE SCIENCES research, e.g., animal husbandry, disease and pest control, ecology, medicine, if a contribution is made to the technology of tracer usage. Also includes extensive bibliographies or reviews.

50.000 MATERIALS

Corrosion, erosion, preparation, fabrication, properties (including solid-state), and phase studies are included with the limitations indicated in the arrangement scheme below.

50.100 Ceramics and Cermets

Limited to the borides, carbides, hydrides, nitrides, and oxides of those elements in Part 2 in which a metallurgy interest is indicated.

50.200 Metals and Alloys

Limited to those elements in Part 2 in which a metallurgy interest is indicated.

50.300 Other Materials

Limited to materials applied or specifically for application in nuclear technology, e.g., carbon, graphite, concretes, plastics.

Radiation damage in or radiation effects on any material with the following exceptions:

Radiation effects on biological materials are included under LIFE SCIENCES.

Radiation effects on chemical or physicochemical properties are included under CHEMISTRY.

52.000 NUCLEAR MATERIALS AND WASTE MANAGEMENT

Equipment, methods, standards, and systems, for safeguarding and management of materials of nuclear interest, e.g., fissionable materials, radioactive materials, radioactive wastes, or materials of special interest such as heavy water. The arrangement is as follows:

52.100 Accountability and Safeguards

Research and development on equipment, methods, and systems to guard against the diversion of nuclear materials from uses permitted by law or treaty.

52.200 Disposal and Storage

Studies, including economic, related to methods for the management, disposal, or storage of radioactive wastes, e.g., land burial, sea disposal, tank storage, or salt mine storage. Geological, hydrological, and seismological studies related to waste disposal are included. Monitoring, transport, and distribution of radioactive materials in the atmosphere, soil, and waters of the Earth are included under ENVIRONMENTAL AND EARTH SCIENCES.

52.300 Handling Equipment and Procedures

Design, construction, and operation of equipment and facilities for handling radioactive materials, e.g., remote-handling equipment, glove boxes, and hot cells. Non-reactor criticality studies are included.

52.400 Transportation

Regulatory and administrative aspects of radioactive materials shipping. Design, development, evaluation, and testing of radioactive materials shipping containers.

Radioactive waste processing is included under CHEMISTRY.

54.000 PARTICLE ACCELERATORS

Particle, ion, atom, or molecule accelerators. The arrangement is as follows:

54.100 Design, Development, and Operation

54.200 Auxiliaries and Components

54.300 Ion Sources and Injection and Extraction Systems

54.400 Ion Optics and Field Calculations

54.500 Storage Rings

54.600 Experimental Facilities (Includes Radiation Targets)

56.000 PHYSICS (ASTROPHYSICS AND COSMOLOGY)

56.100 Cosmic Radiation

Cosmic radiation, including exposure ages and induced radioactivity of extraterrestrial material, e.g., meteorites and lunar material. Cosmic-ray interactions with the atmosphere and with the geomagnetic field are included under PHYSICS (ATMOSPHERIC).

56.200 Stars

Composition, evolution, physical conditions, and nucleogenesis of stars; including neutron stars, black holes, and other starlike objects. Celestial mechanics and routine astronomical observations, e.g., sky surveys, are excluded.

56.300 Quasi-Stellar, Radio, and X-Ray Sources

Theory, detailed studies, and location of such objects.

56.400 Solar Phenomena

Sunspots and solar prominences, disturbances, wind, flares, radio bursts, magnetic fields, structure, and spectra. Solar wind interactions with the atmosphere or geomagnetic field are included under PHYSICS (ATMOSPHERIC).

56.500 Galaxies

Formation, structure, and evolution of galaxies, characteristics of interstellar medium, and identification of molecular species in space.

56.600 Cosmology

Structure and evolution of the Universe, gravitational collapse and detection of gravitational waves, and tests of general relativity. Gravitational wave detectors are included under INSTRUMENTATION. General relativity theory and field theories of gravitation are included under PHYSICS (HIGH-ENERGY).

56.700 Planetary Phenomena

Interplanetary magnetic fields, radio emissions from planets, natural radioactivity of extraterrestrial materials, formation and evolution of planetary systems (including the solar system), and radiation belts. Van Allen belts are included under PHYSICS (ATMOSPHERIC).

58.000 PHYSICS (ATMOSPHERIC)

58.100 Auroral and Ionospheric Phenomena

Associated particle kinetics only.

58.200 Effects of Nuclear Detonations

Atmospheric effects only.

58.300 Magnetospheric Phenomena

60.000 PHYSICS (ATOMIC AND MOLECULAR)

60.100 Beams and Their Reactions

Methods of production and techniques of using atomic, electron, ion, and molecular beams.

Electron and ion sources not developed for specific applications.

Reactions of beams with materials in bulk (e.g., scattering by surfaces, secondary emission, sputtering yields, etc.)

60.200 Atomic and Molecular Properties

Atomic properties (experimental and theoretical studies) of helium, hydrogen (also deuterium and tritium), the lanthanides, scandium, technetium, yttrium, and elements having $Z > 84$.

Molecular properties of deuterium, helium (He_2, He_3, etc.), helium hydrides, hydrogen (H_2, H_2^+, H_3^+, etc.), tritium, and compounds of technetium and of elements having $Z > 84$.

60.300 Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

Properties of positronium, muonium, and muonic and mesic (π, K, etc.) atoms and molecules. Exotic atoms (involving antiprotons, hyperons, etc.) are included under PHYSICS (HIGH-ENERGY).

Basic mechanisms of positron annihilation, but not studies using positron annihilation as a tool.

60.400 Collision Phenomena

Experimental and theoretical studies of elastic scattering, charge exchange (electron capture, electron loss, and electron attachment or detachment), excitation (deexcitation, excitation transfer), ionization, or dissociation in collisions of the following type: electron–ion, electron–atom, electron–molecule, ion–ion, ion–atom, ion–molecule, atom–atom, and atom–molecule.

Rearrangement collisions ($A + BC \rightarrow AB + C$), chemical exchange, and collisions in confined gases when no external beam is involved are excluded.

60.500 Atomic Theory

Theory of atomic structure and properties when generally applicable. For theoretical studies of specific elements, see first statement under Atomic and Molecular Properties.

62.000 PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

Electrofluid and magnetofluid mechanics only.

64.000 PHYSICS (HIGH-ENERGY)

64.100 Particle Interactions and Properties (Experimental)

Experimental studies on the electromagnetic, weak, and strong interactions; on properties of particles and radiation quanta; on hypernuclei and hyperonic or antiprotonic atoms; and on particle or radiation quanta reactions with nuclei above the pion production threshold (~400 MeV). Information on the energy range below 400 MeV is included under PHYSICS (NUCLEAR).

64.200 Particle Interactions and Properties (Theoretical)

Theoretical studies on the electromagnetic, weak, and strong interactions; on properties of particles and radiation quanta; on hypernuclei and hyperonic or antiprotonic atoms; and on particle or radiation quanta reactions with nuclei above the pion production threshold (~400 MeV). Information on the energy range below 400 MeV is included under PHYSICS (NUCLEAR).

64.300 Particle Invariance Principles and Symmetries

Space-time symmetries and internal symmetries of particles and the applications of these symmetries to the electromagnetic, weak, and strong interactions.

64.500 Scattering Theory

General scattering theory only; the application of scattering theory to specific interactions or types of particles is included under sections according to type of interaction.

NOTE: Category 64.400 (Field Theories) is discontinued. This subject area is now included in 76.000 PHYSICS (THEORETICAL).

66.000 PHYSICS (LOW-TEMPERATURE)

Superfluidity, superconductivity, and equipment and devices when emphasis is on the superconductor or superfluid. Applications of superconducting devices are included under sections according to application; e.g., PARTICLE ACCELERATORS.

68.000 PHYSICS (NUCLEAR)

The arrangement is as follows:

68.100 Neutron Interactions with Matter

Neutron absorption, scattering, thermalization, transport, etc., in macroscopic systems, including solution of the neutron transport equation and theoretical neutron transport in matter in general geometric configurations.

68.200 Nuclear Properties and Reactions $A \leqslant 5$

Mass, charge distribution, binding energy, radioactive decay, energy levels and transitions, moments and spin, and nuclear reactions and scattering of specific nuclei, spontaneous and induced fission.

68.300 Nuclear Properties and Reactions $6 \leqslant A \leqslant 19$

Mass, charge distribution, binding energy, radioactive decay, energy levels and transitions, moments and spin, and nuclear reactions and scattering of specific nuclei, spontaneous and induced fission.

68.400 Nuclear Properties and Reactions $20 \leqslant A \leqslant 38$

Mass, charge distribution, binding energy, radioactive decay, energy levels and transitions, moments and spin, and nuclear reactions and scattering of specific nuclei, spontaneous and induced fission.

68.500 Nuclear Properties and Reactions $39 \leqslant A \leqslant 58$

Mass, charge distribution, binding energy, radioactive decay, energy levels and transitions, moments and spin, and nuclear reactions and scattering of specific nuclei, spontaneous and induced fission.

68.600 Nuclear Properties and Reactions $59 \leqslant A \leqslant 89$

Mass, charge distribution, binding energy, radioactive decay, energy levels and transitions, moments and spin, and nuclear reactions and scattering of specific nuclei, spontaneous and induced fission.

68.700 Nuclear Properties and Reactions $90 \leqslant A \leqslant 149$

Mass, charge distribution, binding energy, radioactive decay, energy levels and transitions, moments and spin, and nuclear reactions and scattering of specific nuclei, spontaneous and induced fission.

68.800 Nuclear Properties and Reactions $150 \leqslant A \leqslant 189$

Mass, charge distribution, binding energy, radioactive decay, energy levels and transitions, moments and spin, and nuclear reactions and scattering of specific nuclei, spontaneous and induced fission.

68.900 Nuclear Properties and Reactions $190 \leqslant A \leqslant 219$

Mass, charge distribution, binding energy, radioactive decay, energy levels and transitions, moments and spin, and nuclear reactions and scattering of specific nuclei, spontaneous and induced fission.

69.100 Nuclear Properties and Reactions $A \geqslant 220$

Mass, charge distribution, binding energy, radioactive decay, energy levels and transitions, moments and spin, and nuclear reactions and scattering of specific nuclei, spontaneous and induced fission.

69.200 Nuclear Theory

Nuclear structure, nuclear matter, nuclear reactions and scattering, nuclear moments and spin, radioactive decay, spontaneous and induced fission, and nuclear models.

70.000 PHYSICS (PLASMA AND THERMONUCLEAR)

Plasma and thermonuclear physics, except solid-state plasma, arranged as follows:

70.100 Confinement and Heating

70.200 Diagnostics

70.300 Kinetics (General)

70.400 Kinetics (Experimental)

70.500 Kinetics (Theoretical)

70.600 Production

70.700 Stability

70.800 Thermonuclear Engineering and Equipment

70.900 Wave Phenomena

72.000 PHYSICS (RADIATION AND SHIELDING)

72.100 Radiation Physics

Basic physical characteristics of radiation or of radiation passage through or scattering from materials not generally defined as shielding. This includes experimental or theoretical studies of range-energy relations, energy loss mechanisms, and absorption mechanisms, and calculations of dose distribution in tissue equivalent materials or phantoms. Dose determinations in biological materials is included under LIFE SCIENCES. Neutron transport in macroscopic systems is included under PHYSICS (NUCLEAR).

72.200 Radiation Protection Standards

Standards written for a specific circumstance are included under appropriate sections.

72.300 Radiation Source Calibration and Standardization

Radiation source design and fabrication or radiation source preparation are included under ISOTOPE AND RADIATION SOURCE TECHNOLOGY or CHEMISTRY.

72.400 Shielding Calculations and Experiments

Neutron shielding and shield fabrication are included under PHYSICS (NUCLEAR) and MATERIALS. Shield design is included under sections for the application, e.g., PARTICLE ACCELERATORS or REACTOR TECHNOLOGY.

74.000 PHYSICS (SOLID-STATE)

This category is discontinued. Information on the solid-state properties of materials is now included in category 50.000 (MATERIALS).

76.000 PHYSICS (THEORETICAL)

76.100 General

Theoretical physics applicable to nuclear science (e.g., general quantum theory and mathematical physics) but not specifically applied. Theoretical physics when applied is arranged according to application.

76.200 Quantum Field Theories

Basic studies of quantum field theories and quantum electrodynamics.

76.300 Gravitation and General Relativity

Basic studies of gravitation theory and general relativity theory. Gravitational collapse, gravitational wave detection, and tests of general relativity are included under PHYSICS (ASTROPHYSICS AND COSMOLOGY).

77.000 REACTOR TECHNOLOGY AND REGULATION

Design, development, construction, and operation of nuclear fission reactors.

Includes: fuel elements; cooling systems; pressure vessels; shielding; loading machines; steam and power conversion systems; components; auxiliary systems; accessories.

Excludes: control systems (use 79.400); economics (use 79.500); fuel cycle economics (use 79.600); fuels, general aspects (use 79.300); safety and siting (use 77.900); nuclear insurance (use 77.910).

77.100 Power Reactors, Non-Breeding, Light-Water Moderated, Boiling Water Cooled

Includes: BWR-type.

77.200 Power Reactors, Non-Breeding, Light-Water Moderated, Non-Boiling Water Cooled

Includes: PWR-type.

77.300 Power Reactors, Non-Breeding, Graphite Moderated

Includes: GCR, AGR, HTGR, Molten Salt types.

77.400 Power Reactors, Non-Breeding, Otherwise Moderated or Unmoderated

Includes: Heavy Water type.

77.500 Power Reactors, Breeding

Includes: LMFBR, MSBR, GCFR.

77.600 Research, Test, Experimental, Zero-Power, and Training Reactors and Subcritical Assemblies

77.700 Plutonium Production, Isotope Production, Chemonuclear, Materials Testing, and Material Processing Reactors

77.800 Space, Mobile, Propulsion, Transportable, and Package Reactors

77.810 Nuclear Ships Licensing and Regulation

Safe-navigation regulations.

77.900 Reactor Safety and Environmental Aspects

Reactor accident analysis, safety system performance (e.g., ECCS), environmental consequences of reactor construction and operation, including nonradioactive aspects, in-reactor facility waste processing and radiation protection.

77.910 Reactor Accident Liability

Legal aspects of nuclear damage and risk, insurance, and financial security.

79.100 Reactor Theory and Calculation

Reactor physics calculations and in-pile measurements (in reactors of any type).

Includes: criticality; dynamics; kinetics; lattice cell parameters; neutronics; physics; thermohydraulics.

79.200 Reactor Components and Accessories

Design, construction, assembly, and performance—where no reactor type is specified.

Includes: buildings; coolants; cooling systems; loading machines; pressure vessels; shielding; structures.

79.300 Reactor Fuels

Design, assembly, and performance of fuel elements and assemblies, fuel cycles, fuel handling procedures, and fuel requirements—where no reactor type is specified.

Excludes: production and fabrication of fuel element component materials; burnup in specific reactors types (use 77.100–77.800); fuel cycle economics (use 79.600); loading machines (use 79.200).

79.400 Reactor Control Systems

Systems for the control and surveillance of reactors of any type.

Includes: control elements and incorporated instruments; control element drive units; control by computers; data processing and display systems; systems for alarm and automatic shutdown; automatic initiation of protective systems or actions.

Excludes: instruments of potential use in control systems; safety and protective systems (e.g., ECCS).

79.500 Nuclear Power Plant Economics

General studies of power plant construction and operation.

Excludes: fuel cycle economics (use 79.600).

79.600 Reactor Fuel Cycle Economics

Fuel resources and requirements and overall fuel cycle costs.

79.700 Reactor Licensing and Regulation

All reactor Docket material (must have secondary category to type, e.g., 77.100, 77.200, and any other appropriate category), general licensing procedures and regulations.

80.000 GENERAL

80.100 Civilian Defense

Administrative and planning aspects only.

80.200 Energy Utilization and Economics

Economic and feasibility studies of nonnuclear energy source development and utilization.

Include:

1. Technical results from energy research activities (e.g., coal gasification or desulfurization and synthetic fuel development).
2. Developing technology in electric power generation (e.g., combined cycles) and transmission (e.g., EHV and UHV systems).
3. Comprehensive survey articles on energy sources (solar, geothermal, tides, winds, other) or on energy production and distribution, utilization, conservation, or conversion.

Do Not Include:

1. Popular-type articles.
2. Articles concerning conventional-type hardware (e.g., motors, generators, circuit breakers, gas turbines, gas-transmission equipment, etc.).

Note: Equipment and methods for energy conversion are included under ENGINEERING—Energy Conversion.

80.300 Information Handling

Manual or computer-based systems for data or information acquisition, processing, transmission and retrieval.

80.400 Law

Legislative action and activities of agencies, committees, or organizations.

80.500 Management

Organization, administration, financing, and general description of nuclear institutes and programs, e.g., directories, reference books, manuals, lists of publications, general bibliographies, training programs, etc.

80.600 Mathematics and Computers

Mathematical methods and models and computer codes and programs for solving problems not related to nuclear science.

80.700 Miscellaneous

Publicly available administrative and research and development reports from the United States Atomic Energy Commission and the national nuclear energy organizations of the United Kingdom, Canada, Sweden, Denmark, Japan, Australia, France, West Germany, and Norway which are outside the subject scope of other categories.

Part 2

EXTENT OF INTEREST IN THE ELEMENTS

ACTINIUM

All scientific and technical aspects

ALUMINUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

AMERICIUM

All scientific and technical aspects

ANTIMONY

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

ARGON

Applications of the element in nuclear technology or the behavior of the element in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

ARSENIC

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

ASTATINE

All scientific and technical aspects

BARIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

BERKELIUM

All scientific and technical aspects

BERYLLIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state properties

BISMUTH

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of liquid bismuth
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

BORON

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state properties

BROMINE

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

CADMIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state properties

CALCIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

CALIFORNIUM

All scientific and technical aspects

CARBON

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Properties and fabrication of nuclear-grade graphite and graphite fuel materials

Radiation effects

Radiochemistry

CERIUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Atomic properties

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state properties

CESIUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

CHLORINE

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

CHROMIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

COBALT

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

COPPER

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

CURIUM

All scientific and technical aspects

DYSPROSIUM

Analysis, determination, and separation
Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Atomic properties
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application) compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state properties

EINSTEINIUM

All scientific and technical aspects

ERBIUM

Analysis, determination, and separation
Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Atomic properties
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state properties

EUROPIUM

Analysis, determination, and separation
Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Atomic properties
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state properties

FERMIUM

All scientific and technical aspects

FLUORINE

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

FRANCIUM

All scientific and technical aspects

GADOLINIUM

Analysis, determination, and separation
Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Atomic properties
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state properties

GALLIUM

Applications of the element and its alloys, compounds, and systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

GERMANIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

GOLD

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

HAFNIUM

Applications of the element and its alloys, compounds, and systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state properties

HELIUM

Applications of the element in nuclear technology or the behavior of the element in an actual or a simulated reactor environment
Atomic properties
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Superfluidity

HOLMIUM

Analysis, determination, and separation
Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Atomic properties
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state properties

HYDROGEN

Applications of the element or its compounds and systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment
Atomic properties
Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of deuterium and tritium
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

INDIUM

Applications of the element and its alloys, compounds, and systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state properties

IODINE

Analysis, determination, and separation
Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

IRIDIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

IRON

Applications of the element and its alloys or systems, including steel and stainless steel, in nuclear technology or the behavior of the element, its alloys, or its systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

KRYPTON

Analysis, determination, and separation
Applications of the element in nuclear technology or the behavior of the element in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

LANTHANUM

Analysis, determination, and separation
Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Atomic properties
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state properties

LAWRENCIUM (103)

All scientific and technical information

LEAD

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

LITHIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

LUTETIUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Atomic properties

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state properties

MAGNESIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

MANGANESE

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

MENDELEVIUM

All scientific and technical aspects

MERCURY

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

MOLYBDENUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state properties

NEODYMIUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Atomic properties

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys, compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state properties

NEON

Applications of the element in nuclear technology or the behavior of the element in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

NEPTUNIUM

All scientific and technical aspects

NICKEL

Applications of the element or its alloys, compounds, or systems, in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

NIOBIUM

Analysis, determination, and separation
Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state properties

NITROGEN

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

NOBELIUM

All scientific and technical aspects

OSMIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, *its alloys, compounds, or systems in an actual or a simulated* reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

OXYGEN

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

PALLADIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or *radiation sources)*
Metabolism, tissue distribution, and toxicology of *radioisotopes*
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

PHOSPHORUS

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

PLATINUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

PLUTONIUM

All scientific and technical aspects

POLONIUM

All scientific and technical aspects

POTASSIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

PRASEODYMIUM

Analysis, determination, and separation
Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element,

its alloys, compounds, or systems in an actual or a simulated reactor environment
Atomic properties
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state properties

PROMETHIUM

All scientific and technical aspects

PROTACTINIUM

All scientific and technical aspects

RADIUM

All scientific and technical aspects

RADON

All scientific and technical aspects

RHENIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state properties

RHODIUM

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Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

RUBIDIUM

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Solid-state properties

SCANDIUM

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TELLURIUM

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TERBIUM

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THORIUM

All scientific and technical aspects except mining and routine industrial uses, e.g., thoriated cathodes

THULIUM

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TIN

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TRANSLAWRENCIUM ELEMENTS

All scientific and technical aspects

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URANIUM

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YTTRIUM

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The title abbreviations are based on the National Clearinghouse for Periodical Title Word Abbreviations, *Word Abbreviation List* published by the Standards Committee Z-39 of the American National Standards Institute.

TID-4579 (6th Ed.) *Serial Titles Cited in Nuclear Science Abstracts* lists the titles and abbreviations of the journals regularly scanned for *NSA* as well as those from which an occasional item is taken. This publication is available from the National Technical Information Service (NTIS), U. S. Department of Commerce, Springfield, Virginia 22151, for $6.00 for full size or reproduction copy and $0.95 for microfiche copy.

A

Acta Aliment.
Acta Alimentaria Academiae Scientiarum Hungaricae (Hungary)

Acta Client. Compostelana
Acta Clientifica Compostelana (Spain)

Acta Embryol. Exp.
Acta Embryologiae Experimentalis (Italy)
Supersedes Acta Embryol. Morphol. Exp.

Advan. Hydrosci.
Advances in Hydroscience (U.S.)

AIChE Symp. Ser.
AIChE Symposium Series (U.S.)
Supersedes Chem. Eng. Progr., Symp. Ser.

Aichi-Ken Eisei Kenkyusho-Ho
Aichi-Ken Eisei Kenkyusho-Ho (Report of Aichi Inst. of Public Health) (Japan)

Analusis
Analusis (France)
Supersedes Chim. Anal. (Paris), and Method. Phys. Anal.

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Annales Pharmaceutici (Poznan) (Poland)

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Analele Universitatii Bucuresti, Fizica (Romania)
Supersedes An. Univ. Bucuresti, Ser. Stiint. Natur., Fiz.

An. Univ. Bucuresti, Mat.-Mec.
Analele Universitatii Bucuresti, Matematica-Mecanica (Romania)

Arch. Energiewirt.
Archiv fuer Energiewirtschaft (West Germany)

Astron. Tidsskr.
Astronomisk Tidsskrift (Norway)

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Astrophysics and Space Science Library (Netherlands)

Aust. Weld. Res.
Australian Welding Research (Australia)

Avtomatika
Avtomatika (Ukrainian S.S.R.)
Issued in English translation as Sov. Automat. Contr.

B

Bauplanung-Bautech.
Bauplanung-Bautechnik (East Germany)

Bauwelt
Bauwelt (West Germany)

Ber. Landwirt.
Bericht ueber Landwirtschaft (West Germany)

Brandschutz
Brandschutz (West Germany)

Bruxelles-Med.
Bruxelles-Medical (Belgium)

Bull. Math.
Bulletin Mathematique (Romania)

Bull. Serv. Carte Geol. Alsace Lorraine
Bulletin du Service de la Carte Geologique d'Alsace et de Lorraine (France)

C

Can. Electron. Eng.
Canadian Electronics Engineering (Canada)

Can. Geotech. J.
Canadian Geotechnical Journal (Canada)

Can. Text. J.
Canadian Textile Journal (Canada)

Case Stud. At. Phys.
Case Studies in Atomic Physics (Netherlands)

Catal. Environ. Qual.
Catalyst for Environmental Quality (U.S.)

Chem. Soc. Rev.
Chemical Society Reviews (England)
Formed by merger of Quart. Rev., Chem. Soc. and RIC (Roy. Inst. Chem.) Rev.

Chron. Chim.
Chronache di Chimica (Italy)

Cluj. Med.
Clujul Medical (Romania)

Comput. Struct.
Computers and Structures (England)

Conf. Remote Syst. Technol., Proc.
Conference on Remote Systems Technology, Proceedings (U.S.)

Contr. Syst.
Control Systems (Australia)

Cost Eng. (London)
Cost Engineer, The (London) (England)

D

Defazet-Aktuell
Defazet-Aktuell (West Germany)

Denki Gakkai Ronbunshi, A
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Denshi Keisoku (Instrumentation) (Japan)

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Dock Harbour Auth.
Dock and Harbour Authority, The (England)

Doryokuro Giho
Doryokuro Giho (Japan)

E

Egeszsegtudomany
Egeszsegtudomany (Hungary)

Egypt. J. Genet. Cytol.
Egyptian Journal of Genetics and Cytology (Egypt)

Electron. Appl. Bull.
Electronic Applications Bulletin (Netherlands)
Supersedes Electron. Appl.

Elektroteh. Vestn.
Elektrotehniski Vestnik (Yugoslavia)

Eng. Graphics
Engineering Graphics (U.S.)

Environ. This Mon.
Environment This Month, The (England)

Erdoel-Erdgas Z.
Erdoel-Erdgas Zeitschrift (West Germany-Austria)

F

Faktory Vnesh. Sredy Ikh Znachenie Zdrov'ya Naseleniya
Faktory Vneshnei Sredy i Ikh Znechenie dlya Zdorov'ya Naseleniya (Ukrainian S.S.R.)

Fish. Technol.
Fishery Technology (India)

Folia Morphol. (Prague)
Folia Morphologica (Prague) (Czechoslovakia)

Forum (Chicago)
Forum, The (Chicago) (U.S.)

Fujikura Densen Giho
Fujikura Densen Giho (Fujikura Technical Review) (Japan)

G

Gemeinsames Amtsbl., A
Gemeinsames Amtsblatt, Ausgabe A (West Germany)

Genshi Doryoku Kenkyukai Teirei Kenkyukai Nenkai Hokokusho
Genshi Doryoku Kenkyukai Teirei Kenkyukai Nenkai Hokokusho (Japan)

Geol. Appl. Idrogeologia
Geologia Applicata e Idrogeologia (Italy)

Gradinar. Lozar. Nauka
Gradinarska i Lozarska Nauka (Yugoslavia)

H

Han'guk Sikmul Poho Hakhoe Chi
Han'guk Sikmul Poho Hakhoe Chi (Korean Journal of Plant Protection) (South Korea)

Haus d Tech, Essen, Vertragsveroeff.
Haus der Technik, Essen, Vertragsveroeffentlichungen (West Germany)

Hort. Res.
Horticultural Research (Scotland)

I

Ind. Agr.
Industrie Agrarie (Italy)

Indian J. Agr. Res.
Indian Journal of Agricultural Research (India)

Indian J. Anim. Res.
Indian Journal of Animal Research (India)

Ind. Miner.
Industrie Minerale (France)
Supersedes Revue de l'Industrie Minerale and Mines et Chimie

Int. Met. Rev.
International Metallurgical Reviews (England)
Supersedes Met. Rev.

Ion Exch. Membranes
Ion Exchange and Membranes (England)

Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Biol.-Med. Nauk
Izvestiya Sibirskogo Otdeleniya Akademii Nauk SSSR, Seriya Biologo-Meditsinskikh Nauk (U.S.S.R.)
Changed to Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Biol. Nauk

J

J. Appl. Electrochem.
Journal of Applied Electrochemistry (England)

J. Environ. Qual.
Journal of Environmental Quality (U.S.)

J. Indian Acad. Forensic Sci.
Journal of the Indian Academy of Forensic Sciences (India)

J. Nonmetals
Journal of Nonmetals (England)

JPL Quart. Tech. Rev.
JPL (Jet Propulsion Laboratory) Quarterly Technical Review (U.S.)

J. Polymer Sci., Polym. Chem. Ed.
Journal of Polymer Science, Polymer Chemistry Edition (formerly Journal of Polymer Science, Part A-1. Polymer Chemistry) (U.S.)

J. Polym. Sci., Polym. Lett. Ed.
Journal of Polymer Science, Polymer Letters Edition (formerly Journal of Polymer Science, Part B. Polymer Letters) (U.S.)

J. Polym. Sci., Polym. Phys. Ed.
Journal of Polymer Science, Polymer Physics Edition (formerly Journal of Polymer Science, Part A-2. Polymer Physics) (U.S.)

J. Pub. Health Dent.
Journal of Public Health Dentistry (U.S.)

J. Res. U. S. Geol. Surv.
Journal of Research of the U.S. Geological Survey (U.S.)

K

Kiel. Milchwirt. Forschungsber.
Kieler Milchwirtschaftliche Forschungsberichte (West Germany)

Kobalt
Kobalt (West Germany)

Kogyo Yosui
Kogyo Yosui (Industrial Water) (Japan)

L

Lab. Anim. Sci.
Laboratory Animal Science (U.S.)
Supersedes Lab. Anim. Care

Letop. Khig. Epidemiol. Inst.
Letopisi na Khigienno Epidemiologichnite Instituti (Bulgaria)

Lucr. Stiint., Inst. Agron., Cluj, Ser. Agr.
Lucrari Stiintifice, Institutul Agronomic Dr. Petru Groza, Cluj, Seria Agricultura (Romania)

M

Magn. Resonance Rev.
Magnetic Resonance Review (England)

M.A.N. (Maschinenfabrik Augsburg-Nuernberg)
Forschen, Planen, Bauen
M.A.N. (Maschinenfabrik Augsburg-Nuernberg) Forschen, Planen, Bauen (West Germany)

Med., Sci. Law
Medicine, Science and the Law (England)

Med. Tech.
Medizinische Technik (West Germany)

Meerestechnik
Meerestechnik/Marine Technology (West Germany)

Meld. Norg. Landbrukshoegsk.
Meldinger fra Norges Landbrukshoegskole (Norway)

Meteorologie
Meteorologie, La (France)

Met. Metal Form.
Metallurgia and Metal Forming (England)
Formed by merger of Metallurgia and Metal Forming

Metody Issled. Katal. Katal. Reakts.
Metody Issledovaniya Katalizatorov i Kataliticheskikh Reaktsii (U.S.S.R.)

Mikrobiologija
Mikrobiologija (Yugoslavia)

N

Nachr. Chem. Tech.
Nachrichten aus Chemie und Technik (Supplement to Angew. Chem.) (West Germany)

Nagaoka Kogyo Koto Senmon Gakko Kenkyu Kiyo
Nagaoka Kogyo Koto Senmon Gakko Kenkyu Kiyo (Research Reports of the Nagaoka Technical College) (Japan)

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Neue Physik (Austria)

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Neurologia i Neurochirurgia Polska (Poland)

Nippon Jozo Kyokai Zasshi
Nippon Jozo Kyokai Zasshi (Japan)

Nucleus (Bonn)
Nucleus (Bonn) (West Germany)

Nucl.-Med., Suppl.
Nuclear-Medizin, Supplementum (West Germany)

O

Oesterr. Schwesternztg.
Oesterreichische Schwesternzeitung (Austria)

P

Pressedienst (Bundesmin. Bild. Wiss.)
Pressedienst (Bundesministerium fuer Bildung und Wissenschaft) (West Germany)

Probl. Proch. Mashinostr.
Problemy Prochnosti v Mashinostroenii (U.S.S.R.)

Process Instrum.
Process Instrumentation (England)
Supersedes Instrum. Pract.

Pumps
Pumps-Pompes-Pumpen (England)

Q

Quart. Med. Rev.
Quarterly Medical Review (India)

Quim. Ind. (Madrid)
Quimica e Industria (Madrid) (Spain)

R

Radiol. Prot. Bull.
Radiological Protection Bulletin (England)

Rend. Rom. Gastroenterol.
Rendiconti Romani di Gastroenterologia (Italy)

Rev. Brasil. Fis.
Revista Brasileira de Fisica (Brazil)

Rev. Phys. Technol.
Review of Physics in Technology (England)

Rinsho Seikei Geka
Rinsho Seikei Geka (Clinical Orthopedic Surgery) (Japan)

Riso
Riso (Italy)

S

Scand. J. Met.
Scandinavian Journal of Metallurgy (Sweden)

Seisan To Gijutsu
Seisan To Gijutsu (The Production and Technique) (Japan)

Shinshu Daigaku Kogakubu Kiyo
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Siemens Forschungs-und Entwicklungsberichte (West Germany)

S. Med.
Southern Medicine (U.S.)
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Soobshch. Inst. Agrokhim. Probl. Gidroponiki, Akad. Nauk Arm. SSR
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Sov. Automat. Contr. (Engl. Transl.)
Soviet Automatic Control (English Translation of Avtomatika) (U.S.)

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Soviet Journal of Optical Technology (U.S.)
English translation of Opt.-Mekh. Prom.

Sov. J. Particles Nucl.
Soviet Journal of Particles and Nuclei (U.S.)
English translation of Fiz. Elem. Chastits At. Yadra

Sov. J. Quantum Electron.
Soviet Journal of Quantum Electronics (U.S.)
English translation of Kvantovaya Elektron. (Moscow)

Staub-Reinhalt. Luft
Staub-Reinhaltung der Luft (West Germany)

T

Tech. CEM (Co. Elec. Mec.)
Techniques CEM (Compagnie Electro-Mecanique) (France)

Toxicol. Environ. Chem. Rev.
Toxicological and Environmental Chemistry Reviews (England)

Translog
Translog (U.S.)

Tr. Buryat. Inst. Estestv. Nauk, Buryat. Filial, Sib. Otd., Akad. Nauk SSSR
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U

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Upsala J. Med. Sci.
Upsala Journal of Medical Sciences (Sweden)
Supersedes Acta Soc. Med. Upsal.

Usp. Biol. Khim.
Uspekhi Biologicheskoi Khimii (U.S.S.R.)

Usp. Fotoniki
Uspekhi Fotoniki (U.S.S.R.)

V

Vestn. Mosk. Univ., Ser. Fiz.-Mat. Estestv. Nauk
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W

Welt (Hamburg)
Welt (Hamburg) (West Germany)

Wire Ind.
Wire Industry (England)

Wiss., Wirt., Polit.
Wissenschaft, Wirtschaft, Politik (West Germany)

X

X-Ray Spectrom.
X-Ray Spectrometry (England)

Y

Yo-up Hoeji
Yo-up Hoeji (Journal of the Korean Ceramic Society) (South Korea)

Z

Zast. Bilja
Zastita Bilja (Yugoslavia)

Zesz. Nauk. Univ. Jagiellon., Pr. Fiz.
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Nuclear Power Reactor Instrumentation Systems Handbook

Volume 1

Editors
Joseph M. Harrer, Argonne National Laboratory
James G. Beckerley, U. S. Atomic Energy Commission

This handbook is for designers and operators of power-reactor instrumentation systems and those concerned with applications and not with invention. The accepted practices used in the design of nuclear reactor instrumentation systems are covered, and the systems used on today's power reactors are described. In some cases the plants discussed are still in the design stage. The requirements (or design bases) to be satisfied by each system and subsystem are given first; then the current practices are outlined and evaluated.

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